Understanding the Utilisation of Executive Information Systems Using an Integrated Technology Acceptance Model: Theoretical Base and Empirical Validation

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Abstract:

Over the past decade, a growing number of organisations have been developing executive information systems (EIS) to enhance the performance of their executive managers and facilitate their work. Such systems cannot improve individual and organisational performance if they aren't used. Thus, understanding the key determinants of EIS utilisation is an essential step toward enhancing their impact on individual users and organisational performance. Numerous case studies and explorative surveys of EIS development and implementation have been conducted, but an extensive literature review has shown that theory-based systematic investigations of post implementation use of EIS are rare, especially in the UK.

The study reported here developed and tested a model of EIS usage. The proposed model integrates key constructs from the information systems success factors research stream into the theoretical frame of the technology acceptance model and other theories from social psychology (the theory of reasoned action, the theory of planned behaviour, and the Triandis model of attitude and behaviour). According to the proposed model, EIS usage is determined by six independent variables, namely perceived usefulness, perceived ease of use, information quality, involvement, subjective norm and facilitating conditions. In turn, perceived usefulness is influenced by perceived ease of use, perceived information quality, user involvement, subjective norm, and facilitating conditions. User involvement, perceived information quality and perceived ease of use are determined by four external factors, namely, user participation, information systems maturity, computer training, and user experience.

The model was tested against data from 216 EIS users across various organisations. The results provided considerable support to the research model. In order of importance, subjective norm, perceived usefulness, facilitating conditions, information quality, and ease of use were found to explain 47.1% of the variance in EIS use. User involvement, information quality, subjective norm, ease of use, and facilitating conditions were found to explain 47.6% of the variance in perceived usefulness. Length of EIS use and computer use skill were found to explain 9% of the variance in perceived ease of use. IS maturity and user participation were found to explain 11% of the variance in EIS information quality. Finally, user participation was found to explain 2.4% of the variance in involvement. Implications of the study findings for practitioners and researchers are outlined.

Chapter 1

Introduction to the Study

1.1 Introduction

Over the past decade, a growing number of organisations have been developing executive information systems to enhance the performance of their executive managers and facilitate their work. Simply acquiring the technology is not sufficient; for it to realise the expected benefits its intended users must first use it. Empirical evidence shows that EIS use has a positive impact on executives' decision performance (Leidner and Elam, 1994; Leidner, 1996) and that wider usage of EIS leads to greater impact on the organisation's performance (Watson et al, 1997). Thus, understanding the key determinants of EIS utilisation is an essential step toward enhancing their impact on individual users and organisational performance.

This study defines EIS as "a computerised system that provides executives with information that is relevant to their work" (Walstrom and Wilson, 1997, p. 77). Numerous case studies and explorative surveys of EIS development and implementation have been conducted, but an extensive literature review has shown that theory-based empirical investigations of the determinants of EIS use are rare. Thus, this study attempts to cover this gap in the EIS research by developing and testing a behavioural model of EIS usage. The research model integrates the technology acceptance model and theories from social psychology with important IS success factors. The validity of the model is tested against data from 216 EIS users in the UK. Implications of the study findings for practitioners and researchers are outlined.

1.2 The Underlying Research Philosophy:

Researchers are encouraged to clearly define the research philosophy underpinning their work (Galliers, 1997). The literature suggests two main approaches to the study of executive information systems' development and use, the positivist/rational and the interpretivist/cultural philosophy (e.g., Green and Murphy, 1996; Nandhakumar, 1996). This study adopts an empirical positivist approach to the investigation of the determinants of EIS use. The reason for such choice is the availability of a large body of theoretical and empirical literature related to information systems usage. The danger of under utilising the existing knowledge in this area is the creation of a "new"

area of inquiry in which investigators reinvent theory and learn lessons through their own mistakes rather than through the experience of others (Robey, 1979). Additionally, IS researchers have been criticised by being preoccupied with distinguishing their work from related work rather than emphasising continuity (Adam et al, 1998). Thus the present study builds on and extends the existing body of research on the acceptance of information technology and personal computing to the study of executive information systems usage.

1.3 Research Background:

The EIS is relatively a new member in the family of computer-based information systems. The notion that computer-based information systems could serve the needs of the senior managers started to materialise by Rockart and Treacy's 1982 article, "The CEO Goes On-Line". It presented significant cases where top managers were actually involved in direct access of computer based information systems on regular bases. The appearance of vendor-supplied EIS software by the mid-eighties made it much easier for companies to develop EIS.

EIS was identified as the fastest growing software in corporate America (Watson et al, 1997). Survey figures reflect the growing number of organisations developing EIS to support the work of their executives. The EIS market was expected to climb to $1 billion by 1997 (Hoven, 1996). Trends indicate that approximately 70% of all large firms either have already installed an EIS or are considering one (Bajwa et al, 1998). EIS are also expensive to build and to maintain. Watson, Rainer, and Koh (1991) found that on average the initial cost of developing an EIS in terms of hardware, software, training and personnel is $365, 000, while the annual EIS operating costs were found to average $208,000.

Despite the high potential EIS hold for providing organisational benefits, few have successfully developed EIS (Rai and Bajwa, 1997). Glover, Watson, and Rainer (1992) found that 21 out of 50 surveyed organisations reported that their EIS had previously failed in some way. Another study (Rainer and Watson, 1995) reported that approximately sixty percent of the surveyed firms had experienced an EIS failure. Young and Watson (1995) argue that EIS fail because their potential users do not use them and thus the gains in productivity realised from the investment in EIS had not been at expected levels. Such failure reflects the wide range of managerial and

technical issues that need to be investigated to ensure successful implementation of EIS.

Initial research of EIS has consisted of descriptions of current implementations in organisations, e.g., Rockart and Delong (1988); Elam and Leidner (1995); and Bussen and Myers (1997), and empirical examinations of important EIS characteristics and success factors, e.g., Bergeron et al (1991), and Rainer and Watson (1995). There were in addition exploratory surveys of EIS practices, e.g., Watson, Rainer, and Koh (1991) Fitzgerald (1992), Watson, Rainer and Frolic (1992), and Allison (1996), and consultant reports, e.g., Business Intelligence (1990), and Courtney (1992). Yet research has not extended far beyond the descriptive phase to theoretically based inquiries into the adoption and use of such systems.

Only recently, several studies proposed and tested models of EIS adoption (e.g., Rai and Bajwa, 1997; Bajwa, Rai, and Ramaprasad, 1998) and EIS adoption levels/acceptance in terms of number of actual users as a percentage of potential users (e.g., Rai and Bajwa, 1997; Young and Watson, 1995). Another study proposed a model of the antecedents of EIS success defined in terms of development, maintenance, and enhancement (Bajwa, Rai, and Brennan, 1998). While such models suggest strategies to facilitate the adoption of EIS on the organisational level, very little empirical work aimed at understanding the factors that contribute to the individual use of such systems after being adopted.

While IS literature presents several theoretical models that might explain the individual usage of IT, very few studies (e.g., Bergeron et al, 1995) have attempted to use those theories to establish which factors are important for determining the individual usage of EIS, especially in the UK. Such lack of cumulative results makes it difficult to develop and assess strong theoretical models so that prescriptive actions can confidently be suggested for practice (Benbasat and Zmud, 1999). Therefore, developing a behavioural model to explain the individual use of EIS based on existing theories of IS usage is appropriate.

IS usage was first studied as a surrogate measure of systems success. A number of research models have been proposed in an attempt to examine the determinants of IT usage (e.g., Lucas, 1975; Shewe, 1976, Ein-Dor and Segev, 1978; Zmud, 1979; Ives et al., 1980). Additionally, numerous studies investigated the relations between

individual, organisational, technological and environmental variables and usage (e.g., Swanson, 1974; Lucas, 1978; Robey, 1979; Baroudi, et al., 1986; Culnan, 1983; Raymond, 1990). However, most of their findings were mixed and inconclusive, which was attributed to not basing the relations explored on a sound theoretical foundation (Weill and Olson, 1989).

More recently, IS researchers applied theories from social psychology to explain IS usage (e.g., Davis et al, 1989; Harwick and Barki, 1994; Thompson, et al, 1991; Igbaria, et al, 1997). Fishbein and Ajzen' (1975) Theory of Reasoned Actions (TRA) and its refined version; Theory of Planned Behaviour (TPB) (Ajzen, 1991) have gained widespread acceptance in the research of IT usage. Also, Triandis' model of attitudes and behaviour (1980) attracted the interest of IS researchers because of its inclusion of wider ranges of variables in explaining behaviour.

Among the different models that have been proposed, the Technology Acceptance Model (TAM) (Davis et, al 1989) offers a powerful and parsimonious' explanation of individual user behaviour (Taylor and Todd a, b, 1995). According to TAM, usage is determined by two key beliefs, namely perceived usefulness and perceived ease of use. The empirical validity of TAM was demonstrated through several replications and applications in different IT contexts (e.g., Mathieson, 1991; Talylor and Todd, 1995a; Gefen and Straub, 1997; Sjazna, 1996; Venkatesh and Morris, 2000). However, no previous studies applied TAM in the context of executive information systems (EIS). Additionally, prior studies suggested that TAM's ability to explain usage could be enhanced by extending it to include other important constructs from the IS literature (e.g., Igbaria, et al, 1997).

Based on the models described above and an extensive review of the literature relevant to IT/EIS success factors, this study develops and empirically tests a model of the determinants of EIS usage. The model integrates the technology acceptance model with key constructs found consistently significant in explaining the success of IS/EIS. In accordance with TAM, the proposed model suggests that EIS usage is directly affected by perceived usefulness and perceived ease of use. However, to achieve a more complete understanding of EIS use, the proposed model adds four constructs as determinants of use, those are perceived information quality, user involvement, facilitating conditions, and subjective norm.

The proposed model further extends TAM by suggesting that perceived usefulness, in addition to being influenced by perceived ease of use, will be influenced by perceived information quality, user involvement, facilitating conditions, and subjective norm. Finally the model proposes that perceptions of ease of use, information quality, and user involvement will be influenced by four external factors, namely, user participation in systems development, information systems function maturity, computer training, and user experience.

1.4 Research Problem:

EIS use has the potential for enhancing the performance of managers and the overall performance of the organisation. Like any other computer information systems, the availability of EIS does not necessarily mean that they are used. Even if they are used, they might not be to their full potential. Thus it is important to understand the factors that could contribute to the acceptance and use of such systems by managerial users. Apart from case studies and exploratory surveys, very few attempts to use well-established theories to explain the individual use of EIS are reported in the literature. More over the existing models do not go as far as to provide an explanation of how important beliefs related to EIS use are formed. Thus the research problem is "the lack of theory-based systematic investigations of EIS usage and its related factors".

1.5 Research Objectives:

This research intends to address the research problem by developing and testing a structural model of EIS use. The proposed model is based on the technology acceptance model, theories from social psychology, and relevant constructs from the research on information systems implemetaion success. The model is tested against data from 216 EIS managerial users from the UK. The results are expected to contribute to the literature on executive information systems and the technology acceptance model.

Thus to address the research problem, this study focuses on achieving the following two objectives:

1. To develop a model of the determinants of EIS usage, based on IS usage theories as a foundation.

2. To test the empirical validity of the proposed research model in the UK.

1.6 The Importance of the Research:

EIS is considered a unique computer based information system that has the potential for enhancing the performance of the executive managers and is thus worthy of further research efforts (Leidner, 1996). A recent survey in the UK showed that the ranking of decision support systems have increased to be one of the most important ten IS management issues especially with the advent of executive information systems (Galliers, et al, 1994). EIS is also seen as an emerging technology that despite being introduced some time ago, decision-makers are just beginning to notice its inherent potential (Kendall, 1997). As the use of such systems is mainly voluntary, understanding the key determinants of their utilisation is an essential step toward increasing their value.

From the academic point of view, the study is important because it extends the existing theoretical and empirical research on EIS use and contributes to the research on the technology acceptance model and IT usage generally. Furthermore, the foundation of the research model on previous theoretical and empirical literature contributes to the development of an accumulated body of knowledge describing IT usage and its associated factors. Such a body will allow the comparison of results across different studies and helps the advancement of the MIS field towards the long awaited common tradition.

For executives who are actually using or planning to use EIS in their organisations, understanding the critical variables that could facilitate greater extent of EIS use can help them achieve the most effective deployment of such systems. For IS staff and developers, understanding the important factors related to EIS use will enable them to design more effective strategies to promote higher acceptance and use of EIS among current and potential managerial users. Finally, for EIS software vendors and consultants, this study could provide them with a synopsis of some of the key factors that could add to or undermine their efforts of providing successful products and services to their customers. The validated model could be used as a diagnostic tool to help EIS practitioners understand some of the reasons why some systems are more extensively used than others. The results are also expected to suggest some key factors that could be manipulated to influence the behaviour of EIS potential users in order to achieve a more effective and efficient use of IT resources.

1.7 The Study Bounds:

This study does not claim that the proposed research model explains the entire process of EIS usage. Clearly there are alternative models of EIS use to the one proposed here. However, the development of causal models of systems use provides the means for testing hypotheses about the usage behaviour and the factors influencing it. The empirical validation of such models can be used to make predictions and suggest various strategies for successful systems implementation. Like other theory building studies, this study faces the general criticism of testing obvious relationships, which do not need to be analysed. However, counter-intuitive findings often result from research to test "obvious" relationships (Lucas, 1978). User participation in the system development is an example of general wisdom factors that have generated mixed empirical evidence (e.g., Ives and Olson, 1984; Lei, 1994).

1.8 The Research Plan:

Chapter two (executive information systems and executive work) discusses the managerial roles, executive decision-making, executives' information need, executives' information sources, and executives' use of computers. It then compares EIS with management information systems and decision support systems, defines EIS, and presents a review of EIS functions and capabilities. The chapter concludes by introducing the study's definition of EIS.

Chapter three (theoretical and empirical literature review) presents a review of some of the influential work in IS literature relevant to the explanation of individual use of information systems. Two main research streams are identified, the study of usage as a criterion of IS implementation success and the study of IS usage using theories from social psychology. A review of the empirical studies concerned with testing the validity of prior theories is then presented followed by an evaluative discussion of the models.

Chapter four (the research model and hypotheses) begins with describing the rationale behind the integrated model of EIS use proposed by this study. Then the model's variables, associated hypotheses and an extensive survey of the relevant empirical literature are outlined. The research methodology is presented in chapter five (research methodology). This includes the research hypotheses, the research strategy, the pilot study, the sampling procedure, the survey response, non-response bias

analysis, characteristics of the respondents, definitions and measures of the variables, and the statistical techniques used in the data analyses.

Chapter six (descriptive analyses and evaluation of measurement scales) is divided into two main parts, the first reports on the descriptive statistics of the research variables, and the second reports on the results of the validity and reliability tests of the research variables' measures. Chapter seven (results of hypotheses testing) reports on the results of the correlation and regression analyses used to test the research hypotheses. Finally, chapter eight (discussion of results and implications for theory and practice) presents an evaluative discussion and interpretation of research results. It also discusses the theoretical and practical implications of the results for IS/EIS usage research and practice, identifies limitations in the study, and presents suggestions for future research.

1.9 Conclusion:

The main purpose of this chapter was to outline the objectives of this study and to define its relation to prior research concerned with the determinants of IS/EIS usage. The chapter started with identifying the research philosophy underlying this study. A background summary of relevant research is then introduced followed by a description of the research problem, the research objectives, the research importance and the study bounds. Finally, the research plan is presented. The next chapter is concerned with examining the characteristics of the executive work and the executive information systems supporting it.

Chapter 2

Executive Information Systems and Executive Work

2.1 Introduction

The executive information system itself and the managerial work that constitutes the context of its usage must be key issues for understanding the utilisation of such systems. The objective of this chapter is to examine what executive information systems are and the nature of the managerial work they support. It consists of two parts, the first is concerned with the nature of the executive work and the second is concerned with understanding what constitutes an EIS. The first part discusses the executive roles, executive decision making, executives' information needs, information sources, and use of computer systems. The second part presents the difference between EIS and other management support systems, namely, MIS and DSS, some definitions of EIS, and EIS functions and main capabilities. Finally the study's definition of EIS is presented.

2.2 Understanding the Executive Work:

It is important to consider the existing literature on executive work behaviour because managerial work characteristics and roles determine the extent of impact that computer based information systems can have on the performance of executive work. This study defines the executive as that person in charge of a formal organisation or one of its sub-units (Mintzberg, 1980 p. 166). The following section discusses the characteristics of managerial work and roles, executive decision making, and executive information needs and sources of information including the use of computers.

2.2.1 Managerial Work Characteristics and Roles:

Executive work activities are typically brief, diverse, and fragmented, and demonstrate high degrees of uncertainty. It is very complex, demanding, unstructured, unspecialised, unfocused, unpredicted, disorderly, and long range (Watson et al, 1997). For example, managers dislike long memos and usually skim long reports and periodicals quickly. They also prefer live action and consider activities such as mail processing a burden. The age of information in mail, the lack of immediate feedback in the media, and the unspecific nature of letters were the main reasons behind this

perception (Mintzberg, 1980). Executives have a strong desire to get the most current information. They visit company sites, talk with employees and customers, scan the business environment, and test the validity of the information they receive. They also tend to make little use of the routine reports provided to them.

Performing the myriad tasks necessary to manage complex organisations in today's turbulent environment requires that executives play many different roles. Mintzberg (1980) identified ten roles played by all managers, which he grouped into: three interpersonal roles, three informational roles, and four decisional roles. Different emphases are placed on each role according to the characteristics of the manager's environmental (e.g., industry type and organisation size), job (e.g., level and function), and personality (e.g., demographics and cognitive style).

The first interpersonal role is the "figurehead" acting as the symbol of the organisation representing it to outsiders and employees. The second is the "leader" providing motivation, guidance, and probing into subordinates' activities, looking for information about operations that are going wrong and problems that need attention in addition to staffing, training, and promoting. The third role is the "liaison", developing and maintaining a network of external contacts that provide information and favours.

The first of the informational roles is the "monitor", receiving and collecting a wide variety of information that is interpreted by the manager to develop a thorough understanding of his/her organisation. As monitors, executives scan the environment for information, and receive solicited or unsolicited information from subordinates and other contact. The information that managers receive falls into five categories: internal operations, external events, analyses, ideas and trends, and pressures.

The manager use this information to distribute it to others inside and outside their organisation, to develop value positions for the organisation, to identify problems and opportunities, to build up mental images about the organisation and its environment, and to develop plans of where it must go (Mintzberg, 1980). The second informational role, termed "disseminator", involves passing on information to others in the organisation. The third role, "spokesman," involves disseminating the organisation's information to its environment.

The first decisional role, "entrepreneur", initiating and designing controlled change in the organisation, which involves searching the organisation and environment for opportunities. As entrepreneurs, executives are intentional initiators of change, which alter the organisation to meet rapidly changing environment. In the second role "disturbance handler," the manager is responsible for taking corrective actions when the organisation is faced with important, unexpected threats. Hence in this role executives are forced to deal with conditions beyond their control, such as impending strikes. Thirdly, the "resource allocator" role includes the allocation of the organisation's resources such as labour and capital for which the demand always exceeds the available supply. In this role the manager decides where his organisation will expand its efforts. Finally, in the "negotiator" role, the manager enters negotiations on behalf of his organisation. In the automobile industry, for example, a dispute between the design and engineering departments will be negotiated by the vice president of manufacturing who manages both departments (Watson et al, 1997).

The managerial roles were defined before the rise of the end-user computing. Thus Mintzberg (1980) argued that traditional information systems which provided internal, precise information of an aggregate and reference nature were not adequate for the manager who largely needs external, current, speculative information of a trigger nature. However, careful consideration of many of the managerial roles uncovers the strong impact of information over their performance. This provides reasons why information technology could be used to support many of the managerial roles.

Many of the suggestions made by Mintzberg for the potential of science in programming the manager's job (Mintzberg, 1980) is becoming reality through the introduction of office automation systems, decision support systems, and executive information systems (Rockart and DeLong, 1988). For example, electronic and voice mail provide managers with direct feedback and real time communication and information dissemination media unlike traditional paper mail. Capabilities such as the electronic calendar and tickler files could be useful in scheduling the activities of mangers and thus enable executives to spend more time on the more important tasks of their job. DSS provide managers with data analyses and modelling capabilities that could be used in supporting semi-structured and unstructured decisions.

Executive information systems have the potential for improving planning and control processes and enhancing the manager's way of thinking about his organisation and its

environment by providing scanning capabilities of internal and external databases. Moreover, the availability of soft information in the EIS provides managers with an important information source that was previously only accessible through informal verbal media. (Watson et al, 1997).

Despite the potential of EIS to increase executive effectiveness and efficiency, it still does not affect many of the executives' work activities, for example, the role of the executive as a spokesman for the organisation or as a negotiator (Holtham, 1992). A recent survey, (Valhos and Ferratt, 1995) asked a sample of 55 managers to evaluate the value of IT support for Mintzberg's decision roles. For the whole sample the manager's role as "resource allocator" received the highest rating, while the "negotiator" role received the lowest rating. Therefore, an executive information system is best seen as a supporting tool to only some aspects of the executive work.

The decisional roles warrant special attention because they are "probably the most crucial part of the manager's work - the part that justifies his great authority and his powerful access to information" (Mintzberg, 1980, p.77). The next section describes the decision making process and the role of EIS in supporting it.

2.2.2 Managerial Decision Making

Decision-making is considered the simplest paradigm for managerial activities (Watson et al. 1997). The executive work does not only include making decisions personally, but also seeing that his subordinates are taking the right decisions as well. To create a framework within which decisions could be related to the use of computer based information systems, two aspects of the decision need to be examined: decision types and the process of making the decision. Decisions can be categorised on a scale ranging from programmed or structured (concentrated at the top-level management) to non-programmed or unstructured (concentrated at the lower level management). (Simon, 1977).

Inventory control is an example of a structured decision. It is routine, occurs frequently, the information requirement are known in advance, and causal relationships are clear. On the other end of the scale, executive decisions are non-programmed. Non-programmed decisions are typically taken in a unique situation never previously encountered, are consequential, in which alternatives and consequences are not clearly known, and the information requirements to support the

decisions are neither known nor understood. They usually have long time horizons and a high degree of discontinuity, involve abstract data and causal relationships, high uncertainty, ambiguities in preferences, and no assumptions. Determining the amount of money to spend in a new research and development project, is one example of such decisions.

Different types of computer-based information systems are suitable for supporting each decision type. Transaction processing systems and management information systems deal with the well-structured, short term, and small impact decisions. Decision support systems and executive information systems are more suitable for the more complex, less repetitive, high impact and long term decisions. Additionally, the goals and design techniques for developing information systems to support structured decisions differ from those of the unstructured decisions. In the first case, the main goal of an information system is to improve the processing of information. While for unstructured decision the main goal of an information system is to improve the decision-maker's and the organisation's performance through better access to quality information (Gorry and Morton, 1971).

Anthony (1965) presents another widely accepted model of decision types. His model suggests that there are three main categories of decisions made in the organisation corresponding to the three levels of managerial activities i.e. strategic planning, management control, and operational control. Strategic planning involves making decisions on objectives of the organisation, on changes in these objectives, on the resources needed to attain them, and on the policies that are to govern the acquisition, use, disposition of these resources. Decisions in this category involve predicting the future of the organisation and its environment and are typically taken by a small number of high-level people who operate in a non-repetitive and often creative way. The development and introduction of a new product is an example of strategic decisions.

Management control involves confirming that resources are obtained and used effectively and efficiently in the accomplishment of the organisation's objectives. Decisions in this level deal with the use of the resources in the organisation and frequently involve financial and human problems. Budget control is an example of managerial control problems. Operational control, is the process of ensuring that specific tasks are carried out effectively and efficiently. Decisions in this level deal

with the day to day problems that affect the operation of the firm. Inventory control and production scheduling are examples of the operational control decisions.

Considering the nature of the problems in the three levels of managerial activities, it is more likely that strategic decisions constitute most of the decisions handled by top management while operation control decisions constitute most of the decisions faced by supervisors. A recent study reported that managers rated the value of IT support highest for the short-term operational control decisions and lowest for strategic long-term decisions (Valhos and Ferratt, 1995).

A number of decision models exist in the literature that could be used to understand how are decisions made. Simon's (Simon, 1977) popular model of decision making process consists of three stages: the intelligence stage, the design stage, and the choice stage. The intelligence stage is concerned with searching the environment for conditions calling for decisions. This includes gathering information to identify and describe the decision problem i.e., the difference between some existing situation and some desired situation. The desired situation is the mental model that the executive has for the business and its environment. The EIS provide managers with early warning signals to help detect existing and potential problems or opportunities through improved access to internal and external databases, exception reports, unscheduled queries, and drill down to data to look for the causes of the problem (Hoven, 1996).

The design stage refers to the identification and evaluation of the alternative solutions for the decision problem. Although the generation of alternative solutions mainly depends on the human creativity and judgement, the EIS can significantly assist in identifying a greater number of quality alternatives, exploring more alternatives in less time, and testing these solutions for feasibility (Hoven, 1996). Ad-hoc querying of internal and external databases facilitates the process of alternatives generation, while what-if analyses and decision modelling capabilities can provide quick and accurate evaluation of the generated alternatives.

Finally, the choice stage in which the actual decision is being made based on the first two stages. An EIS can assist the executive in selecting a certain course of action from those available by providing data manipulation, modelling, and simulation capabilities. A fourth stage, namely implementation, is added to Simon's model, in

which the executive insures that the decision is carried out (Lucas, 1994). At this stage the EIS provides the manager with performance control reports and exception reports to help monitor the progress of the decision. This provides the executive with current feedback on the implementation of the decision. A recent survey of managers reported that they rated the value of IT support highest for the evaluation step in decision making and least for generating alternatives (Valhos and Ferratt, 1995).

In structured decisions the three phases of decision making are completely structured. On the other hand, all decision stages of the unstructured decisions are fully unstructured. Decisions that fall between those two extremes are semi-structured (Lucas, 1994). In making decisions, executives use both intuition and the rational approach to define the problem, develop and evaluate alternative solutions, and select the appropriate one. They identify problems quickly using their intuition, and they respond without thinking to make programmed decisions, they synthesise isolated bits of data and experience, and check on the accuracy of quantitative analyses (Watson et al, 1997). Hence computer based information systems cannot replace the executive in decision making rather they are only tools which effectiveness depend on the way they are used by the executive.

2.2.3 Information the Executive Needs:

One important input to decision making is information, it is also the output of computer based information systems (Hough and Duffy, 1987). Information is defined as "some tangible or intangible entity that reduces uncertainty about some state or event" (Lucas, 1994 p. 30). The nature of the decision problem, personal and situational factors, cognitive style of the decision-maker, and the organisational setting affect how managers interpret the information they receive. Executives use information for many purposes: to find out where their attention should be focused, to identify organisational problems, and to establish alternatives and select courses of action. Information helps stimulate creativity, generate scenarios, determine trends in the environment, monitor performance status, and control various activities (Gorry and Scott Morton, 1971).

Information has many characteristics such as, time frame, accuracy, scope, source, and frequency (table 2-1). The importance of these characteristics varies with the decision type and the organisation level of the manager (Lucas, 1994). For operational

control decisions, executives need historical information. Usually the results are expected and the source of information is internal. The information must be detailed, and because operational control decisions involve day to day operations of the firm, the information must correspond closely to real time. The information also tends to be highly structured and precise.

On the other hand, information for strategic decisions tends to be more predictive and long-range in nature. Strategic planning may uncover many surprises and often requires external data on the economy, the competition, and so forth. There is usually no need for highly detailed or extremely precise information. The requirements for management control decisions fall between those of operational control and strategic planning.

Table 2-1 Information Characteristics versus Decision type (Lucas, 1994, p. 41)

	Decision type		
Characteristics	Operational control	Management control	Strategic control
Time frame	Historical	→	Predictive
Expectation	Anticipated	→	Surprise
Source	Largely internal	→	Largely external
Scope	Detailed	→	Summary
Frequency	Real-time	→	Periodic
Organisation	structured	→	Loosely structured
Precision	Highly precise	→	Not overly precise

Executives need both internal and external information (Watson et al, 1997). Internal operation information is needed regularly by the executive. They consist of key indicators of the status of the operations within the organisation. This information comes from the standard operating reports, ad hoc information from subordinates, or from the organisation tours. Examples of this type of information include: actual performance versus expectation, percentage of product return, customer delivery cycle, customer satisfaction, trends in employee attitude, employee turnover rate. It may come in the form of analyses, pressures, problem presentation, and highlight charts.

External information covers the external environment including clients, competitors, market changes, political changes, technological developments, and so on. Such

information may come from personal contacts, trade magazines, and periodicals. Information about new ideas and environmental trends may come from attending conferences, unsolicited letters from customers and clients, suggestions from suppliers, or the print or broadcast media. External information also includes general surveillance data that enable the executive to better identify the threats and opportunities.

Executives also need soft information such as opinions, predictions, news and even rumours in addition to hard information that focuses on internal operations and relies heavily on financial data. While hard information provides the facts, soft information enhances the facts and helps executives spot trends and raise questions thus enriching the decision-making process. Holtham (1992) reports on a survey, which asked senior mangers to describe the information they use. The responses show that 85% use sales information, 83% use budget/forecasts, 37% use market trends, 35% use external information, 35% use economic data, 30% use competitors activity data, and 30% use other. He concludes that the present financial and hard data orientation of most UK executive information systems fit them well for the planning and control purpose, but less well for supporting the mental model of the executive.

Executives acquire information by various means ranging from scanning, i.e., browsing through information without a particular problem to solve or problem to answer, to focused searches; i.e. seeking information for solving well defined problems. Focused searches lead to improvements in efficiency. On the other hand, browsing or scanning may lead to more consequential breakthroughs involving fundamental changes in the managers' assumptions. Scanning is particularly important to senior managers because they usually face unstructured problems (Watson et al, 1997).

2.2.4 Sources of Executive Information:

Information can be received by managers in various forms: printed output and graphics, verbal, and visual observations, and from different sources. Information systems in organisations could be classified into computer-based systems and non computer-based systems (Hough and Duffy 1987). Mintzberg (1980) identified five information media available to managers, namely observational tours, documents, telephone calls, and scheduled and unscheduled meetings. His study of the behaviour

of five Canadian chief executives found that they spend 78% of their time in verbal activities. He also reported on prior studies, (Stewart, 1967; Burns, 1954) which found that British managers spend from 66% to 80% of their time in verbal communications. Mintzberg was thus critical of computer-based systems as information producing mechanisms for senior managers.

In an in-depth interview Mcloed, Jones, and Poitevent (1984) asked five senior managers to rank ten information sources according to their value in supporting their work. The rankings were: (1) Memos and letters, (2) scheduled meetings, (3) telephone, (4) unscheduled meetings, (5) non-computer reports, (6) computer reports, (7) office visits, (8) periodicals, (9) conventions, (10) social/civic activities. The main findings of this study are that executives rely more heavily on informal sources of information than formal. Approximately three times as much as information comes from non-computer sources as from computer sources. Moreover, twice as much information comes from internal sources as from external. Finally, verbal media are the most preferred sources.

In a follow up research, Jones and McLoed (1986) examined five senior executives' use of information systems. They divided all information sources into written or oral. Written media include computer reports, letters, memos, periodicals and non-computer reports. Oral media included social activity, business meals, tours, telephone calls, and scheduled and unscheduled meetings. Written media were found to account for the majority of executive information sources (61%). Consistent with prior results, executives put more value on verbal media because of its greater information richness. Of the written media, memos and non-computer reports were considered more valuable than computer reports.

A recent survey of 74 senior executives in large corporations asked managers to rate the frequency of using 11 sources of information (Benard and Satir, 1993). Based on average frequency of use, the rankings were: (1) Reports prepared outside the company (2) Meetings with people outside the company (3) Computer printouts (4) Direct use of computer workstations on the executive desk (5) Reports prepared inside the company (6) Memos and information bulletins. (7) Telephone conversations with people outside the company (8) Outside publications. (9) Outside documents addressed directly to the executive. (10) formal or informal meeting with company personnel. (11) Telephone conversations with company personnel. Those results

show an improvement in managers' ranking of computer sources and an emphasis on external sources compared to internal ones.

2.2.5 Executives' Use of Computer Systems:

During the last two decades, information technology has become increasingly available to support managers in making decisions, for planning, controlling and operating their corporations. Several studies have been directed to advance the understanding of managers' use of computers and the amount of time they spend using them. In a study of senior managers' use of computers, Mittman and Moore (1984) conducted a phone survey of 107 companies, 51% reported some direct use of computers by at least one senior manager. In the second phase of the study, 19 executives from 14 companies were personally interviewed about their direct computer use behaviour. Surprisingly, the results pointed to relatively high use of computer; for example executives averaged 4.5 hours per week use of computers and 84% of them wrote their own programs. The results also revealed that the use executives made of computers was related to communicating decisions or justifications much more often than to decision making or decision evaluation activities.

Hough and Duffy (1987) conducted a survey of 1,985 top managers, out of the 130 managers who reported to have heard of DSS, 39 do not use it at all, 74 use it indirectly or occasionally, and 17 use it directly. Additionally, The majority of users of DSS belonged to the middle management. Valhos and Ferratt (1995) reviewed prior findings concerning the amount of computer use by managers. They reported that hours of IT use range from 1.8 hours per week to 2 or more hours per day and that non-managers used IT more than managers. Their review also revealed that the majority of managers are not using IT as much as might be expected. Valhos and Ferratt (1995) also conducted a mail survey of 1000 managers in Greece, results from 55 responses indicated that those managers used information technology as a valuable, every day tool, with an average use per week of 9.6 hours. They also found that operation level managers use computers twice as much as top and middle level managers. Spreadsheet /financial report preparation was the dominant software used, and information reporting systems dominated the types of CBIS used.

It seems that the reported low rating of senior managers' use of computer-based information sources may reflect that previous systems originally thought to serve them (e.g., MIS, and DSS) have provided little support. This lack of support is rapidly changing as executive information systems are being developed in a growing number of firms (Bajwa et al, 1998). The next section focuses on the examination of executive information systems.

2.3 What Constitutes an Executive Information System:

To achieve a fuller understanding of what constitutes an EIS, this section starts with comparing EIS with other management support systems, namely, MIS and DSS. Some definitions of EIS are then introduced, followed by an examination of executive information systems functional types and capabilities. Finally, the definition of the EIS deployed in this study is presented.

2.3.1 The Difference between MIS, DSS, and EIS:

There have been many attempts to develop computer-based information systems to serve the management over the past thirty years. Such systems should be of considerable benefits to management to support their different work aspects and help them face the turbulent environment in which they work. However, attempts in 1960s to provide information systems to serve the needs of the management were not successful (Eason, 1992). This was contributed to the lack of appropriate technology and skilled IS staff. Decision support systems then emerged during the late 1970s, which was directed to support the decision-making aspect of the manager's work. However, such systems did not offer the executives the tools they needed, thus there still was lack of proper information systems support for executives (Partanen and Savolainen, 1995). Understanding the difference between MIS, DSS, and EIS may explain why the first two failed in serving the needs of the management users and why EIS may have better chances in fulfilling such difficult task.

Millet and Mawhinney (1992) define MIS as "a system that allows managers at various organisational levels to get detailed and summarised information from operational databases". The operational databases are typically created by "transaction processing systems" (TPS). While DSS is defined as "computer based systems that help decision makers confront ill-structured problems through direct interaction with data and analyses models" (Sprague and Carlson, 1982, in Watson et al, 1997).

According to these definitions, the common ground shared between EIS, MIS, and DSS is that they are all designed to provide relevant information to decision makers. EIS are similar to MIS in terms of the scope of the information provided. In practice, however, MIS mostly provided control information in the form of summary and exception reports. More sophisticated MIS may even allow ad-hoc query of organisation database. They were in effect a layer on top the transaction processing system, and thus the characteristics of the TPS limited the capabilities of the MIS (Millet et al, 1991). A TPS is often developed in an independent fashion to support a particular organisational function, which resulted in MIS that lacked integration across functional areas. This limitation becomes severe when attempting to satisfy the needs of top-management for comprehensive, organisation wide information.

EIS is also distinct from DSS although the former may include several functions of the latter. Where the purpose of EIS is monitoring and scanning of the environment to give executives rapid exposure to changes, the purpose of DSS is to support ad hoc decisions as well as some routine analyses. EIS also serves higher managerial tasks than DSS and while the core of DSS is extensive modelling and analyses capabilities, the core of EIS is status information about the organisation's performance (Leidner and Elam, 1994).

DSS are also narrow in scope providing information about specific ill-structured decision-making tasks often using mathematical modelling. They are usually used for a single or few decision-making instances as in ad hoc DSS or they may be employed on on-going bases as in the case of institutional DSS. Decision support systems could also be used to support problems with different levels of specificity and recurrence (Adam et al, 1998). They are typically used by staff professionals or middle management rather than by senior managers (Millet and Mawhinney, 1992). Even when DSS are part of the EIS, most often executives employ staff people to operate the DSS (Watson et al, 1997).

2.3.2 Executive Information Systems Defined:

Many definitions have been used for EIS based on the scope the system served. For example an executive information system (EIS) is defined as "a computer-based information system that provides executives with easy access to internal and external information relevant to their management activities" (Watson, Rainer, and Koh,

1991). It can also be defined as "a computer based information system which can organise and present data so as to provide information which support the analytical, communicative, and planning needs of executive users" (Carlisle and Alameddine, 1990). However, this definition presents a strict view that few systems that are widely recognised as EIS could satisfy.

While a definition is useful, a richer understanding is gained by describing the characteristics of EIS (Watson et al, 1997). EIS are generally characterised as information systems that are:

- tailored to the individual executive users,
- extracting, filtering, compressing, and tracking critical data,
- providing online status access, trend analyses, exception reporting, and drill-down,
- accessing and integrating a broad range of internal and external data,
- presenting graphical, tabular, and textual information,
- user friendly and require minimal or no training,
- direct hands on use by executives without intermediaries,
- designed to support the decision making process by delivering usable and relevant information,

EIS can also help executives develop or enhance their mental model of the business and its relationship to the environment in which it operates.

Despite that executive information systems were originally designed for senior executives, they are now serving managers at all the organisation levels and knowledge workers as well. EIS has grown to become everybody's information system or enterprise intelligence systems (Stamen, 1992). In this study the letter "E" in the term "EIS" stands for executive. The "Executive Information Systems" (EIS) and "Executive Support System" (ESS) terms are often used interchangeably. However the term "Executive Support System" usually refers to a system with broader set of capabilities than EIS. While EIS is mostly concerned with providing information, ESS encompasses other support capabilities in addition to EIS capabilities. According to Watson et al (1991) those may include:

- Electronic communications e.g. e-mail, v-mail, and computer conferencing.
- Data analyses capabilities e.g. spreadsheets, what-if analyses, query language.

- Office automation tools e.g. word processing, electronic calendar, automated Rolodex, and tickler files.

The above definitions only provide a guiding framework to help focus on some of the important component that make a computer system seen as an EIS. However, in practice many executive are still using their EIS indirectly through intermediaries (Bartholomew, 1997) and will continue to do so as long they perceives that they can get what they need without putting the needed effort in making direct use of the system (Eason, 1992). Also the exclusion of data analyses capabilities from EIS would limit the ability of such systems to be used in supporting planning and decision making processes, which are considered one of the main purposes for which such system were used (Rai and Bajwa, 1997).

2.2.3 EIS Functions and Capabilities:

Investments in EIS have increased because of their potential benefits. They provide better logistics, efficient communications to more people, and increase visibility into the organisation and facilitate the understanding of the business (Rockart and Delong, 1988). Moreover, they provide improvements in the quantity and quality of information made available to executives from internal and external sources. This includes providing more timely, concise, and relevant information, faster access to information, new or additional information, and more external information. EIS also improve the executive's job performance through improved executive planning, organising and controlling, as well as enhanced communications, decision making, and mental models. It can also support organisational objectives such as greater response to customers, improved product or service quality, and downsizing the organisation (Watson et, al, 1997).

When executives focus their use of EIS to answer specific questions or solve well-defined problems, they help to fine-tune operations and verify assumptions. However, an EIS may also lead an executive to challenge fundamental managerial assumptions and preconceptions when using it to scan through information without having specific questions in mind. In this mode, an EIS may be used to help formulate problems and foster creativity - thereby improving organisational effectiveness. EIS use was found to contribute to gains in efficiency much more frequently than to gains in effectiveness (Vandenbosch and Huff, 1997).

An organisation's ability to scan the external environment and incorporate anticipated changes into its strategic plan foster organisational adaptability and survival. Executive information systems that include external data address the challenges associated with effective environmental scanning by providing an efficient means of information acquisition, storage and retrieval. Frolick et al (1997) outlined how EIS can be used to streamline each step in the environmental scanning process. These steps are: aiding in the determination of relevant external issues, providing proactive scanning abilities to seek the status of these issues, aiding decision makers in analysing the impact of these issues, and provide communications channels to departments within the organisation.

According to Rockart and Delong (1988), EIS can be viewed along two dimensions, the function that the managers perform and the managerial purpose for which the executive uses the system. Along the first dimension, they suggest that executives use three types of functions: (1) Communications-based applications including electronic mail and computer conferencing. (2) Status access to predetermined reports, which are updated regularly. A hierarchy of menus allows the executive to move from one report to another and enables regular monitoring of the organisations' performance. (3) Query and analysis capabilities, which allows the manager to perform random and unstructured analysis of data or modelling, and can be created using forth generation tools or spreadsheet packages which may be linked to the corporate data base.

Along the second dimension, three managerial purposes underlie the use of EIS capabilities. (1) The support of particular office functions to enhance the executive's efficiency and effectiveness. (2) Improving the organisation's planning and control processes. The objective of this type of EIS can range from merely enhancing the existing control system to changing fundamental aspects of the way in which the organisation is managed. (3) Clarifying and enhancing the executive's mental model of the firm's business environment.

According to Watson et al (1997) EIS can provide executives with four main functions. The first and most important one is to provide high quality information which is timely and accurate and which contain the correct level of details the executive require. EIS reduces the information overload by acting as information filter. It also enables executives to access and assimilate information with less effort. Secondly, EIS can provide executives with both internal and external information.

Current status screens supply internal operations information, comfort information, and top-level financials. Moreover, problem information, highlight charts, and exceptions are colour coded on these screens. While access to various external databases provides information on external events, external intelligence, and environmental trends.

Thirdly, EIS may provide access to electronic and voice mail. This function allows executives to communicate more efficiently inside and outside their organisation. Finally, EIS has the potential to help executives formulate, assess, and modify their mental models through its handling of the overabundance of information coming from the complex and turbulent internal and external environment of their organisation. However, the executive work remains difficult to support because it is so unpredictable and demanding no matter how advanced the EIS are.

Walstrom and Wilson (1997) reported on four functional types of EIS: (1) to improve information access; (2) improving communication; (3) solve problems; (4) monitor performance. Firstly, EIS systems to improve information access provide data focused on important indicators or dimensions to the executive. Much of this function is provided from a transaction information system and traditional management information system, but not in the meaningful, focused, and customised fashion desired by an executive. Secondly, EIS systems to improve communications provide terminal-based access to electronic mail and computer conferencing. The executive's terminal is usually networked to others in the company. Access to sources outside the organisation such as the Internet may be available.

Thirdly, EIS to solve problems provide classical DSS capabilities allowing the executive to perform random and unstructured analyses of data, or modelling. The sophistication of analyses differs from user to user. Finally, EIS to monitor performance, or control systems, provide access to pre-determined pre-formatted sets of electronic reports. The frequency of updating the data used to generate such reports depends on the nature of the data. Executives also need "read only" access to the latest data or reports on key organisational variables.

Based on the above EIS functional types, Walstrom and Wilson (1997) developed a categorisation of EIS users by querying 98 of the Corporate 1,000 CEOs on the ways in which they used their EIS. Their responses were grouped and compared with EIS

functions. The findings indicated three basic "types" of EIS users termed as converts, pacesetters, and analysers. The "converts" appear to have adopted EIS as a replacement of previously existing systems. Users indicated an emphasis on the use of EIS to access information previously provided in written reports or computer print outs. They showed comparatively lesser use of EIS for communication and/or data analyses functions. 21% of the respondents using EIS fell into this cluster.

The "pacesetters" reported more frequent use of most of the EIS functions. They appear to use EIS for communication and access of external information more frequently. 71% of the respondent fell into this cluster. The third type, analysers, used the EIS mainly to perform analyses of data and ad hoc querying of organisational databases. Users in this group constituted 7% of the respondents. Further investigation revealed three dimensions underlying these types: organisational monitoring, information access, and organisational understanding.

A recent survey of ESS usage in Fortune 500 companies (Nord and Nord, 1996) revealed that ESS is used for purposes of decision making and scheduling by 50% of the respondents, 43% used their ESS for E-mail, 37% used it for electronic briefing. Finally, tickler and follow up functions are used by 31.3%. The study showed that ESS allows senior executives to access critical information, which was not otherwise available to understanding and assessing situations quickly, electronically confront and communicate problems, report information as a combination of graphics, tables, and text, and make schedules, set agendas, and follow up on matters.

As the use of EIS spread across organisations, the number of users with access to the system and the capabilities offered by it increased. In a survey of 50 organisations that use EIS, Watson, Rainer, and Koh (1991) found that EIS initially supported eight users. After three years the number gradually grew to an average of 120 users. Moreover, the systems initially provided 56 screens with the number increasing to an average of 500 after three years. A follow up study surveyed 51 organisation and found that the EIS initially supporting ten users with 63 screens expanded in three years to cover 100 users with 500 screens (Watson, Rainer, and Frolic, 1992). The use of EIS is also evolving beyond the board level. A much wider group of managers lower in the hierarchy are becoming users and this represent a very considerable aspects of the rapidly growing demand (Matthews, 1992).

The increase in the number of users with access to EIS leads to corresponding increase in EIS capabilities and features. Based on a comprehensive survey of various EIS software in the U.S. market place, Carlisle and Alameddine (1990) developed a representative set of attributes that could be used to evaluate EIS software capabilities. Those include analytical capabilities, office support capabilities, and planning capabilities.

Analytical capabilities include:

1. Unstructured questions, which enables the executive to make ad-hoc querying.
2. Decision support features, such as what-if analyses, which enable the manager to manipulate data.
3. Drill-down; gives the executive the ability to look into successive levels of details behind a summarised figure.
4. Exception reporting; provides the manager with indicators of deviations in variables that need to be regularly monitored from pre-set values.
5. Trend analyses; is usually in the form of time series data presented in a graphical format.
6. Tracks of key indicators; allow the executive to specify a variable such as a critical success factor and trace it over time.
7. Key word searches; allows the executive to search a database using a string of characters.
8. Textual explanation; explains to the executive in words the highlights and trends of a particular table or graph.
9. Pre-defined reports on critical success factors.
10. Traffic lights; use different colours to highlight significant increase or decrease in data to attract the attention of the user.

Office support capabilities include:

1. Electronic mail: allow executives to communicate across space and time via messages, memos, and reports.
2. Company news: allows executive to be informed about events happening within the company.
3. News services: provide executives with access to external information provided by commercial news companies.

4. Word processing: enable the executive to prepare and review documents, letters, and speeches.
5. Electronic calendars: provide a system to manage the executive's calendar electronically. It can also facilitate group meeting scheduling among executives.
6. Automated Rolodex: provides automated access to a database of people.
7. Tickler files: electronically store an executive's things to do or monitor the completion of activities.

Planning capabilities include project management, which provides managers with tools to create charts, and/or other project management tools.

Partanen and Savolainen (1995) used data from 132 Finnish and English EIS users and eight technical staff members in eight organisations to describe the utilisation of the functional properties of EIS applications for office support analytical support, and project management across top, middle, and operational management levels. The results show that analytical support capabilities are essential EIS characteristics. Users of such applications can be found throughout the managerial levels, though more applications are installed in top management systems. Drill down, trend analyses and exceptional reporting were built in every EIS surveyed. A possibility to add textual explanation to graphic pages was included in nearly all EIS systems. However, what if analysis and key word search were less frequently integrated in the surveyed EIS applications.

On the other hand, office support applications were less frequently installed in the EIS systems. About 25% of those systems did not contain any office support applications. The most frequently installed office applications were electronic mail, word processing, and news services. Electronic calendar and tickler files tended to be infrequent applications as they were installed in only one system. The most common applications among top management users were news services and electronic mail. One explanation for infrequent installation of office support applications is that the managers have not used these applications prior to the advent of EIS systems as they are regarded as secretarial duties. Additionally, some EIS products do not include any office support capabilities. Project management applications were used in only 1% of the sampled systems. However, the authors found that such applications were used in many of the companies surveyed but they were not integrated in the EIS.

Watson, O'Hara, Harp, and Kelly (1996) studied the use of soft data in executive information systems. Data collected from 32 EIS developers showed that speculations, forecasts, estimates, and predictions were used in 78% of the respondents' EIS. Explanations, justifications, assessments, and interpretations were included in 66% of the systems. In third place came news reports, industry trends, and external survey data in 63% of the systems. The least included information were opinions feelings, and ideas at 15.6% and rumors, gossip, hearsay at 9.4% of the systems. The study results indicated that the inclusion of soft information in EIS is positively related to its perceived value.

Little attention is directed to the use of multimedia in executive support systems. An experiment was conducted to assess the use of multimedia in EIS and its potential impact on the effectiveness of information analysis (Huang and Windsor, 1998). Data were collected from 40 managers and/or professional employees in three business organisations. The primary task was to analyse information stored in an ESS prototype in order to identify some possible threats and opportunities. The results show that managers and professional employees who used a multimedia ESS identified fewer threats and opportunities than did those who used a text-based system. Additionally, the use of multimedia did not improve information retention. During the post-experiment interview, subjects indicated that the use of sound annotations had adversely affected their ability to analyse information. Those results suggest that multimedia may not be an appropriate presentation format for analytical tasks.

2.4 The Study's Definition of EIS:

This study defines EIS as "a computerised system that provides executives with information that is relevant to their work" (Walstrom and Wilson, 1997, p. 77). In the following chapters, EIS will refer to the narrower term executive information systems, rather than the wider term executive support system. The study focuses on the EIS functions of information access for the purpose of problems solving, and performance monitoring. It thus excludes the EIS office support functions such as e-m and word processing from the application domain of the empirical study.

Despite that executive information systems were originally designed for senior executives, they are now serving managers at all the organisation levels (Bajwa et al,

1998). A recent survey of mangers' use of ESS reveals that executive support systems are no longer used only by senior executives but managers at all levels are putting these systems to strategic use (Nord and Nord, 1996). Empirical evidence also show that there is no difference in the outcome of EIS use for senior and middle managers suggesting that EIS is relevant in both levels (Leidner and Elam, 1995). In accordance with prior studies on EIS use, namely Bergeron et al (1995) and Leidner (1996) this study will refer to both top and middle management levels as EIS managerial users.

2.5 Conclusion:

This chapter was directed towards understanding the managerial work and the executive information systems designed to support it. The first part of the chapter presented a review of some of the important work related to the nature of the managerial work. Mintzberg managerial roles were discussed and a conclusion was drawn that information technology is able to support many of the managerial roles. Then a review of decision types and the decision-making process were introduced followed by an examination of the managers' information needs, information sources, and executives' use of computers. The second part of this chapter was concerned with understanding what constitutes executive information systems. Firstly, EIS is compared with MIS and DSS, which shows that EIS is more suited for serving the special needs of management users. Some EIS definitions were then introduced followed by a discussion of EIS functions and capabilities. The chapter concluded with a definition of the EIS deployed in this study.

The literature review presented in this chapter underline the unique characteristics of EIS, and the complex context in which they are used. The advent of such systems has made it possible to study the managerial use of computer-based information systems, which is the least studied usage behaviour in the IS literature (Leidner and Elam, 1994). While various models of IS usage were proposed and tested in the information systems acceptance/usage literature, very few studies have attempted to build on this foundation to understand the factors that contribute to the use of EIS. In pursuit of this objective, the next chapter presents a comprehensive review of IS usage theories relevant to the explanation of the individual use of information systems. This review represents the theoretical foundation of the EIS use model proposed by the present study.

Chapter 3

Theoretical and Empirical Literature Review

3.1 Introduction:

This chapter is concerned with establishing the theoretical foundation on which the proposed model is based. It presents a review of the theoretical and empirical literature concerned with the research on information systems usage. Information systems researchers stress the need to build IS research on a cumulative tradition, using referent disciplines and theoretical arguments as a foundation (Benbasat and Zmud, 1999). This is especially true when trying to understand the behaviour of using executive information systems that is mainly driven by voluntary users (Trice and Treacy, 1988; Bergeron et. al, 1995).

Over the last 30 years many factor and process studies have attempted to predict and explain the adoption and use of IT (Barki and Benbasat, 1996). However, most of their findings were mixed and inconclusive. These conflicting results were attributed to not basing the relations explored between different independent variables and usage on a sound theoretical foundation and poor attention to construct measurement (Weill and Olson, 1989). As a result a parsimonious set of reliably and validly measured factors known to influence IT use behaviour could not be proposed.

Fishbein and Ajzen's (1975) Theory of Reasoned Actions (TRA), and its refined version; Theory of Planned Behaviour (TPB) (Ajzen, 1991) have gained widespread acceptance in the research of IT usage determinants. Also, Triandis' (1980) model of attitudes and behaviour attracted the interest of IS researchers because of its inclusion of a wide range of variables in explaining behaviour. The Technology Acceptance Model (TAM) (Davis et al., 1989) has achieved considerable level of empirical validity (e.g., Adams et al, 1992; Chau, 1996; Davis et al., 1989; Davis, 1993; Mathieson, 1991; Taylor and Todd, 1995 a, b; Sjazna, 1996).

The wide spread acceptance of such models could be useful in establishing a set of cumulative results, which integrates and builds on past findings. This chapter reviews the theoretical and empirical literature concerned with the research on information systems usage. Two research streams are identified: implementation factors and process research, and research based on the attitude-behaviour link from social psychology. Firstly, the chapter introduces a brief review of some of the key models

in the IS implementation literature in which usage is studied as an important criterion of implementation success.

Secondly, it presents a more detailed account of some theories from social psychology recently used by researchers to understand IS usage. This is followed by some of the key work that applied such theories in the context of IS. Those theories are then evaluated in terms of their relative ability to explain usage. To conclude, the chapter suggests the integration of main constructs from the referent theories with key success factors from the IS implementation literature as a bases for the proposed model of EIS usage.

3.2 The Study of Usage as a Criterion of IS Implementation Success:

Assessing the intended or actual use of the system is one of the most extensively used measures of information system success by IS researchers (Delone and McLean, 1989). A number of research frameworks / models have been proposed in an attempt to identify the key determinants of information systems success (e.g., Ein-Dor and Segev, 1978; Ives et al., 1980; Lucas, 1975; Lucas et al., 1990; Shewe, 1976; Schultz and Slevin, 1975; Zmud, 1979).

Lucas (1975) developed and tested a descriptive model of information systems implementation in the context of the organisation. According to this model systems use is a valid criterion of success only if it is voluntary, otherwise the use of alternative implementation success criteria such as user satisfaction is recommended. The model proposes that usage is directly determined by situational and personal factors (e.g. education, age, and organisational level), management support, decision style, user attitudes and perception of the system, and system quality.

Schewe (1976) developed and tested a model relating beliefs, perceptions, attitudes, and use. According to the model, attitudes result from a set of evaluated beliefs about the system. These attitudes along with beliefs about exogenous factors to the system are hypothesised to affect the degree of systems use. Despite that Schewe' model represents a theoretical step forward in the study of usage behaviour, the lack of validated measures of the construct included in the model diminished its empirical validity.

In their framework for organisation context and MIS effectiveness, Ein-Dor and Segev (1978) present three groups of organisational variables that correlate with MIS

success, namely, uncontrollable, partially controllable, and controllable variables. Uncontrollable variables are those factors whose status is given with respect to the MIS because the time required to change them is well beyond the time frame of MIS implementation. Even in the long run, there is very little that could be done to induce change in this group of variables. This group includes variables such as the size and structure of the organisation.

The partially controllable variables are those susceptible to change within a time frame compatible with that of the information system. Their exact values cannot be chosen at will but changes in the desired direction can be induced. The variables in this group include organisational resources, organisational maturity, and the psychological climate in the organisation. Finally, controllable variables are those completely under the control of the organisation's top management. Their exact values or status can be precisely determined by the organisation at any time. These variables include location of the MIS manager and the steering committee in the organisation.

Ein-Dor and Segev proposed a series of hypotheses, which relates these variables to the successful implementation of MIS measured in terms of systems usage, user satisfaction, and systems impact on performance. They claim that although performance is the main goal of IS implementation, the difficulties inherent in its measurement and the assumption that the three measures of success are mutually interdependent make system usage an appropriate criterion of systems success.

Zmud (1979) argues that a large amount of research activities was directed to understanding the influence of individual differences upon MIS design, implementation, and usage. He classifies the individual differences most relevant to MIS success into three classes: cognitive style, personality, and demographic/situational variables. Based on a synthesis of previous research he proposed a model of the influence of individual differences on MIS success (use, satisfaction, and decision performance via MIS).

The model conceptualises two paths by which individual differences can influence MIS success, namely: cognitive and attitudinal. On one path individual differences amplify or dampen limitations in human information processing or decision making (cognitive behaviour), which in turn impose MIS design characteristics directed

towards the facilitation of MIS usage. On the other path individual differences influence the attitudes held by potential users as well as their intention to involve themselves in the MIS development effort.

Ives, Hamilton, and Davis (1980) presented a comprehensive framework of IS research. According to this model usage is influenced by five groups of environment variables.

1. External environment variables includes cultural, economic, educational, and industry factors.

2. Organisational environment variables such as organisational goals, tasks, structure, and management style.

3. The user environment variables described in terms of the characteristics of the users and their tasks.

4. Development environment variables, which consist of development methods and techniques, designer characteristics, and existing information systems that may interface with the system under development.

5. MIS operation environment incorporates all resources necessary for the system operation including software, hardware, databases, and support personnel.

Jenkins (1982) argues that more detailed topic-specific programmes of research are more useful to the individual researcher. Thus, he proposed a programme of research that focuses on the user-system interface of decision support systems. According this model, human, systems, and task factors interact to affect the performance of the system. The extent and type of the system use is categorised as a performance variable. The human factor includes demographic and psychological aspects, managerial style, motor skills and motivation. The task factor includes function, level, and environment. The information system factor cover variables related to input, process, and output of the information system.

Genzberg (1980) presented a general model of organisational contingencies of accounting and information systems implementation. The model identifies use as an implementation outcome in addition to satisfaction with the system and improved task performance. According to the model the interaction between characteristics of the

system designers, the system users, the system itself, and the organisation result in mediating conditions, which in tern determine the success of the implementation

Ginzberg suggests that the interaction of the characteristics of the designer and the user determine the quality of the implementation process, while the interaction of the user with the system's characteristics determines the individual system fit. Finally the interaction of the system with the organisation's characteristics determines the organisational fit of the system. The greater the organisational fit, individual system fit, and the quality of the implementation the greater the likelihood of the successful outcome (which includes greater use of the system).

The previous frameworks exemplify the implementation factors research because of their preoccupation with identifying key success factors of IS implementation. They generally assume a direct link between various explanatory variables and implementation outcomes including usage. Such frameworks provide information systems researchers with a vessel into which past and future studies could be classified and from which research hypotheses may be generated. The following models suggest a more complete picture of the IS implementation process.

Zand and Sorensen (1975) developed a model of IS implementation based on the Lewin-Schein change model, which divides change into three stages: unfreezing, changing, and re-freezing. In the unfreezing stage the users are prepared for a change in behaviour due to a MIS implementation. In this stage potential users are made to feel that the organisation needs the system in order to improve performance. The changing stage moves the users into a new pattern of behaviour; in this stage the system is actually implemented. Finally in the re-freezing stage the new change is institutionalised, that is it becomes an integral part of the regular way of doing things. Zand and Sorensen (1975) proposed hypotheses about implementation forces that correlated with successful change in each of the three stages.

According to this model, organisational and individual factors influence the change process, which in turn determine the success of the implementation. The model equates implementation success with the degree to which the MIS is institutionalised in the organisation. Utilisation is often used as a surrogate measure of the degree of institutionalisation. The rationale behind this is the more a system is used the more it becomes an integral part of an organisation.

Another widely used model for the study of IS implementation is the diffusion of innovation theory (Rogers, 1980) which is concerned with individual's reactions to new technologies and the reasons why some diffuse while others do not. Moore and Benbasat (1991) drew upon the innovation of diffusion theory and identified a set of six important perceptions that influence the adoption of IT. These are: relative advantage, compatibility, ease of use, trialability, image, and result demonstrability. However, the adoption of innovation theory does not elaborate on how those perceptions are formed and how do they lead to adoption or rejection of an innovation.

Kwon and Zmud (1987) proposed a six-phase model of the implementation process. Each stage in this model is linked with a specific stage in the Lewin' model of change. Kwon and Zmud's (1987) model proposes that the initiation stage of the IS innovation coincides with the unfreezing stage. The adoption and adaptation stage is linked with the change stage. In their model, IT usage is seen as part of the refreezing process and it occurs following the acceptance of the new technology and could lead to performance improvement and satisfaction if the use is voluntary and the performance is dependent on the use.

The models proposed by Zand and Sorensen (1975), and Kwon and Zmud (1987) are notable exceptions from the implementation models discussed earlier because they are based on existing knowledge in the behavioural sciences. The main difficulty with testing those models is that they fail to identify a set of operational variables in each of the implementation stages.

Although not fully inclusive, the following list exemplifies the key factors related to implementation success (usage): organisational/structural factors, environmental factors, task-related factors, individual factors, and technological factors (Kwon and Zmud, 1987; Rivard and Huff, 1988). Numerous empirical studies investigated the relationship between those factors and IS success/usage (e.g., Baroudi, et al., 1986; Culnan, 1983; Lucas, 1975; 1978; Lucas, et al., 1990; Raymond; 1985; 1990; Robey, 1979; Swanson, 1974).

Evaluative reviews of empirical literature of IS implementation reveal that most of the findings were mixed and inconclusive with low explained variance (Kraemer and Dutton, 1991). The IS implementation research is criticised by being fragmented with

most researchers following quite narrow perspective and only few studies following a well-defined program as well as the lack of a dominant paradigm. This makes it difficult to position individual studies within a fuller body of research (Kwon and Zmud, 1987).

The following section reviews the theoretical and empirical literature related to attitude-behaviour theories from social psychology recently used by IS researchers to explain systems usage. It is believed that they provide a stronger theoretical foundation for the study of IS usage behaviour as well as allow its integration with key implementation success factors. The theories described in the following section provide the underlying foundation for the theoretical model proposed by this study.

3.3 The Study of IS Usage Using Theories From Social Psychology:

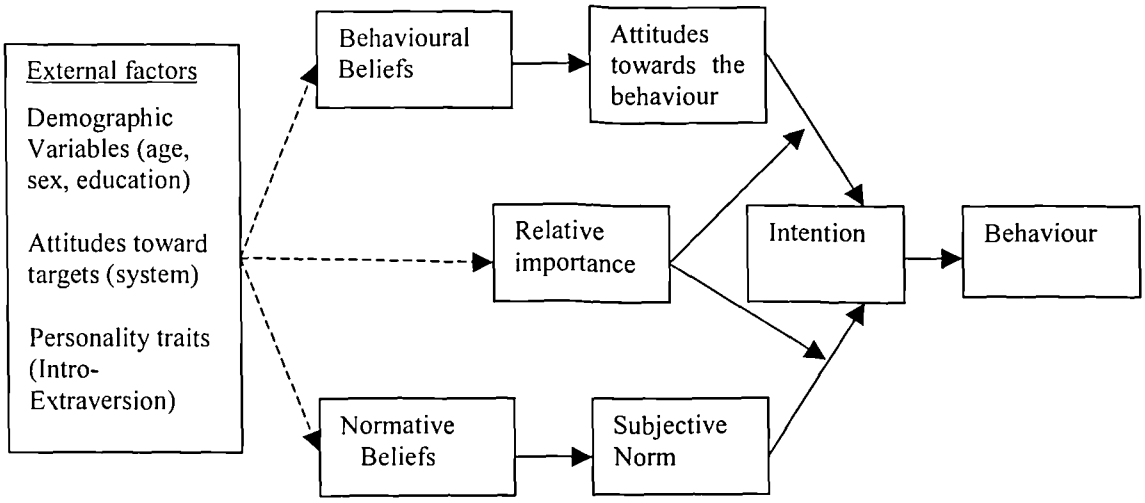
The ultimate goal of the group of theories discussed below is to explain why an individual behaves in a certain way. These theories are based on the assumption that at the individual level of analysis it is possible to explain and predict human behaviour by reference to a small number of concepts embedded within a theoretical framework (Fishbein, 1980). It is only through the search for more comprehensive and formal theories of behaviour rather than seeking unique explanations of different behaviours that the understanding of IT use behaviour could be advanced. This section starts by a discussion of the foundation and constructs of the theory of reasoned action, the theory of planned behaviour, the Triandis model, and the technology acceptance model. A review of the empirical studies concerned with testing the validity of those theories is then presented

3.3.1 Theory of Reasoned Action (TRA)

The theory of reasoned action (Fishbein and Ajzen, 1975) (Fig. 1) is directed toward predicting actions under volitional control, i.e. situations in which the individual has the choice to do or not to do the behaviour. Therefore, a person's Behaviour (B) is solely and directly determined by his intention to perform the behaviour. Since the TRA aims at understanding behaviour and not merely predicting it, the second step is to identify the determinants of Behaviour Intention (BI).

According to the theory of reasoned action, a person's intention is a function of two determinants one is personal in nature and the other reflects social pressures. The first factor is termed Attitudes towards the behaviour (A) and refers to "the individual's

positive or negative feeling (evaluative affect) about performing the target behaviour" (Fishbein and Ajzen, 1975, p 216). The second variable is termed Subjective Norm (SN). This reflects the person's perception of social pressures on him or her to perform or not to perform the behaviour. SN is defined as "the person's perception that most people who are important to him think he should or should not perform the behaviour in question" (Fishbein and Ajzen, 1975, p.302).



*Solid arrows represent theoretical relationships linking beliefs to behaviour

**Dotted arrows represent a possible explanation for observed relationships between external factors and behaviour.

Fig. 3-1 Theory of Reasoned Action (Fishbein, 1980, p.104)

Generally speaking, people will tend to perform certain behaviour after they have evaluated it positively and after they believe that important others think they should perform it. Weights are assigned to attitude and subjective norm according to their relative importance in predicting behaviour, which differs from one situation to the other and from one person to the other (Fishbein, 1980).

According to the theory of reasoned action, attitude concerning behaviour is a function of beliefs. Generally speaking a person who believes that performing certain behaviours will lead to mostly positive consequences will hold positive attitudes towards the behaviours. The beliefs that underlie attitudes towards behaviour are termed behavioural beliefs. These are defined as the probability that the behaviour leads to certain outcomes multiplied by the evaluative affect (desirability) of these outcomes.

Subjective norm is also a function of different kind of beliefs, namely, normative beliefs. These are the person's beliefs of the probability that specific individuals or groups think he or she should or should not perform the behaviour multiplied by motivation to comply with the specific referents' prescriptions (Ajzen and Fishbein, 1980). If the person believes that most of these referents think he should perform the behaviour, the perceived social pressure to perform it will increase to the extent he is motivated to comply with each of these referents (Fishbein, 1980). Finally, behavioural and normative beliefs are determined by external factors such as the characteristics of the individual and the behaviour object.

As depicted in figure 3-1, behaviour can be explained through a limited number of constructs. At the most global level behaviour is determined by intention. At the next level, intentions are explained in terms of attitudes and subjective norms. The third level explains attitudes and subjective norm in terms of beliefs about consequences of performing the behaviour and about the normative expectations of relevant referents. (Fishbein, 1980). One advantage of the TRA is that it helps identify which of those variables contribute most to the behavioural differences.

The movement from behaviour to intention, from intention to attitude and subjective norm, and from these two to their underlying beliefs increases the understanding of the factors influencing the behaviour under consideration. This gained understanding, according to the theory of reasoned action, is not accompanied by any gains in the prediction over that provided by intention alone.

Moreover, the theory of reasoned action acknowledges the role of other "external" factors that are often related to behaviour, though it questions the assumption that those variables are directly related to it. Thus according to the TRA, the external factors represent a fourth level of explanation as they may provide insight into why people differ in their behavioural beliefs, outcome expectations, normative beliefs, or motivation to comply. This also makes it possible to account for many inconsistencies in the literature concerning the relationship of external factors with behaviour (Fishbein, 1980).

3.3.2 Theory of Planned Behaviour (TPB):

The theory of planned behaviour is an extension of the theory of reasoned action (figure 3-2). It was introduced to account for the original model's limitations in

dealing with behaviours over which individuals do not have complete volitional control (Ajzen, 1991). Ajzen argues that behavioural intention can find expression in behaviour only if the individual has the required abilities and resources needed to perform the behaviour in question.

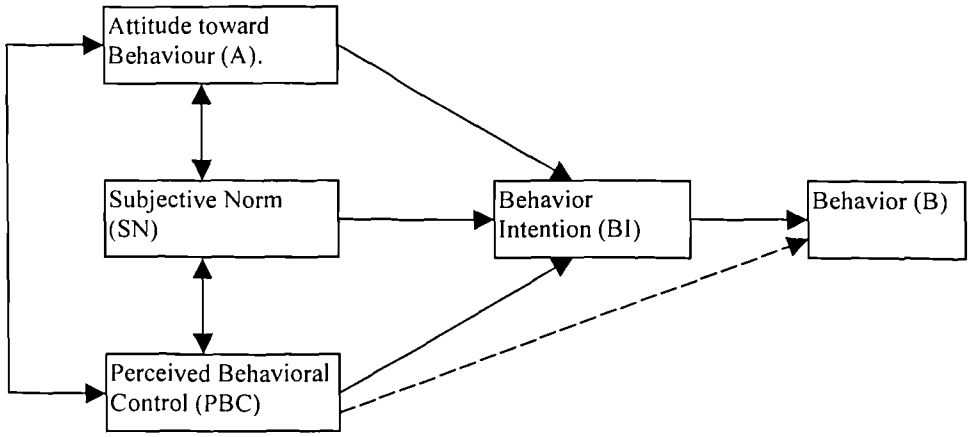


Fig. 3-2 Theory of planned behaviour (Ajzen, 1988 p.133)

Hence, the theory of planned behaviour included the construct "Perceived Behavioural Control" (PBC) as the second determinant of behaviour (in addition to intention) as well as the third determinant of intention (in addition to attitudes and subjective norm). PBC is defined as "the extent to which the person believes he or she is personally in control of the performance of the behaviour in question" (Ajzen, 1988). This includes perceptions of internal and external control. Internal control refers to the individual's possession of the skills and capabilities needed for the performance of the behaviour, while external control refers to the availability of resources and opportunities necessary for facilitating the behaviour.

Ajzen (1991) argues that perceived behavioural control also refers to people's perceptions of the ease or difficulty of performing the behaviour and to beliefs of self-efficacy: one's belief in one's capability to perform a task (Bandura, 1977). However, it is important to note that perception of behavioural control is a valid predictor of behaviour to the extent it is realistic. Given that past experience with certain behaviour is seen as the most important source of information about behavioural control (Ajzen, 1991), PBC plays an important role in mediating the influence of past behaviour on current behaviour.

Both of the theory of reasoned action and the theory of planned behaviour stress the importance of assessing the model constructs at identical points of generality in terms

of target, action, context, and time. According to the principle of compatibility, the more compatible the target, action, context, and time elements of the variables measured, the stronger the statistical relationship between them (Ajzen, 1988). They also agree on the role of external factors in understanding behaviour. According to both theories, external variables such as individual characteristics, involvement with the behaviour, and experience, do not hold consistent effects on behaviour, unlike intention, perceived behavioural control, attitudes, subjective norm and beliefs.

3.3.3 Triandis Model of Behaviour and Attitudes:

Despite the acceptance of the Triandis theoretical framework (Triandis, 1980) within the psychological literature, IS researchers have only recently adapted it to the explanation of IS use behaviour (Thompson et. al., 1991; 1994; Bergeron et. al, 1995). Triandis proposed a "theoretical network of interrelated hypotheses around the concept of behaviour and attitudes placing them in the largest possible context" (Triandis, 1980 p 196).

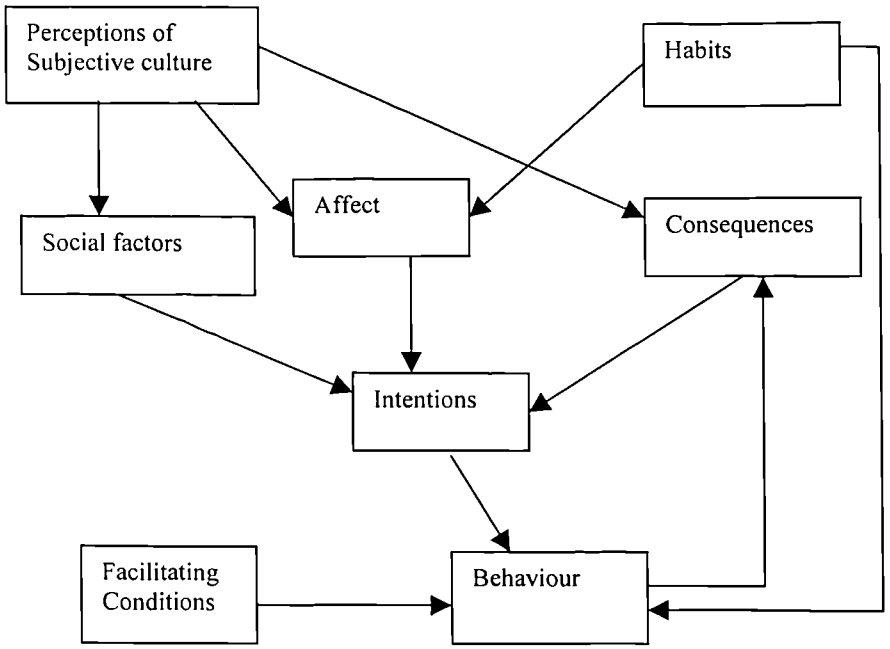


Fig. 3.3 A Subset of Triandis' Model of Behaviour and Attitude (Bergeron et al, 1995)

The model incorporates many of the concepts in the theory of reasoned action and the theory of planned behaviour. For the purpose of the study reported here, only the

subset of the model recommended by previous IS researchers as most relevant for explaining IT use behaviour will be discussed (figure 3-3).

Akin to the theory of reasoned action and the theory of planned behaviour, Triandis' model relates behaviour to intention. However, it hypothesises that objective "facilitating conditions" that could intervene and impede the behaviour and related habits are direct determinants of individual behaviour as well. The Triandis' conceptualisation of "facilitating conditions" is different from the TPB's perceived behavioural control, which is subjective and depends on the individual's assessment of the skills and the resources available to him.

According to Triandis, an individual may have the intention to perform a certain behaviour, but is unable to do so because the environment prevents the act from being done. Consequently facilitating conditions are important in explaining an individual's behaviour, and must be taken into consideration. Additionally, behaviour is frequently performed based on established habits without any planning beforehand. Thus Triandis argues that a person's habits should also be considered as direct determinants of behaviour.

Social factors, affect, and behaviour consequences determine intentions. Social factors consist of the internalisation that people make of the subjective culture of the reference group to which they belong or with which they interact most frequently. Social factors and subjective culture are similar to TRA' social norms and normative beliefs. Affect relates to the individuals feeling of pleasure, displeasure, joy, delight or disgust toward a given behaviour. Affect is influenced by subjective culture. Positive feelings will increase the intention towards a given behaviour, while negative feelings will decrease them. Affect is similar to TRA' attitude construct.

The factor "consequences" is defined as the probability that a perceived consequence will follow from performing the behaviour weighed by the value attached to the consequence (Triandis, 1980, p. 203). Consequences are similar to the construct of behavioural beliefs in the TRA. Like social factors and affect, consequences are influenced by the individual's perceptions of subjective culture variables. In addition to influencing behaviour through intentions, consequences are influenced by it. Thus, objective consequences of a behaviour are interpreted by the individual and "as result of these interpretations, the person feels reinforced"(Triandis, 1980, p198).

3.3.4 The Technology Acceptance Model TAM:

The Technology acceptance model TAM is an adaptation of the theory of reasoned action especially designed for predicting and explaining IT usage (Davis et al., 1989). According to TAM (figure 3-4), usage behaviour (B) is directly determined by behavioural intention (BI). Intention is a function of attitude toward usage (A) and perceived usefulness (PU). Attitude reflects "feelings of favourableness toward using the system" while PU is defined as "the degree to which the person believes that using a certain technology will enhance his or her performance" (Davis, 1989, p.380). Attitudes are influenced by beliefs about system use, specifically PU and Perceived Ease of Use (PEOU). The latter is defined as the "degree to which a person believes that using a certain system is effort free" (Davis, 1989, p320).

Perceived usefulness is directly determined by ease of use while both of them are determined by external variables (Figure 4). Examples of external factors from IS research include computer training (e.g., Nelson and Cheney, 1987) organisational characteristics (e.g., Raymond, 1990), computer experience (e.g., Fuerst and Cheney, 1982), attitudes towards systems (Ives, Olson, and Baroudi, 1983), and user participation (e.g., Baroudi et al, 1986). By examining the effect of such variables on user perceptions and attitudes, TAM provides a useful theoretical base for integrating different IS research streams.

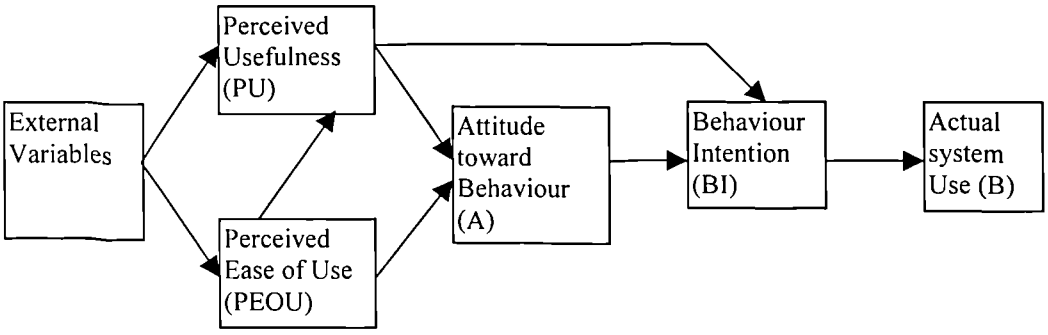


Fig. 3.4 The Technology Acceptance Model (Davis et al, 1989)

TAM and TRA agree that attitudes are determined by behavioural beliefs. However they differ in the way of defining beliefs. While TRA defines beliefs in correspondence to the specific behaviour in terms of action, target, context and time, TAM introduces two fixed sets of beliefs, usefulness and ease of use, that could

generally explain attitudes toward usage of different systems and among various sets of users. This makes TAM a more practical and less expensive tool for predicting and explaining IS use. Also the separation of the belief components enables tracing the influence of each of them on attitude and guides the efforts towards effective ways of changing it.

TAM also differs from TRA in two significant ways. Firstly, TAM postulates a direct link between perceived usefulness and the intention to use. This direct relation contradicts the assumptions of TRA that attitudes mediate the influence of behavioural beliefs on intentions. Secondly, TAM excludes subjective norm as a predictor of behaviour intention. This exclusion could make TAM more suited to situations of voluntary use, i.e., when the individual has discretion about whether to use the system or not.

The following section reviews some of the key empirical studies that applied, compared, and extended the technology acceptance model, the theory of reasoned action, the theory of planned behaviour, the Triandis' model of attitude and behaviour to the understanding and prediction of IT usage behaviour.

3.3.5 Empirical Evidence:

Davis et al. (1989) compared the technology acceptance model and theory of reasoned action in predicting and explaining the use of a word-processing application. In a longitudinal study of 107 students, intentions to use the application, measured after one-hour demonstration of the system, was able to predict usage measured after 14 weeks. Moreover, the intention-usage relation was stronger at the end of this time period. The data provided partial support to the TRA. While attitudes showed a positive impact on intention in both times, subjective norm had no effect on intention.

In regards of TAM, the results showed that perceived usefulness is a strong determinant of intention pre and post implementation. Attitude had a weak influence on intention when measured one hour before the actual use (time 1) and no influence at the end of the 14 weeks period (time 2). Perceived ease of use had insignificant influence on perceived usefulness at time one, but this effect increased and became significant over time. In both times, TAM was able to explain more variance in use intention than TRA.

Mathieson (1991) compared TAM with TPB in predicting intention to use information systems. University students were asked to decide between using a calculator or any familiar spreadsheet application to perform an assignment. They were made aware that their grades would not be affected by their decision. The findings showed that perceived usefulness and attitude positively influence intention. The detected impact of attitude is inconsistent with previous findings (Davis et.al, 1989).

On the other hand, the findings showed partial support to the TPB. Attitude and perceived behavioural control positively influenced intention, while subjective norm had no significant influence. These results are not surprising considering that no pressure is made on the students to use the spreadsheet system. Mathieson concluded that TAM was easier to use because it employed a standard set of instruments, thereby eliminating the need to elicit beliefs for every new IS context and that a parsimonious causal structure for predicting behaviour could be based only on usefulness and ease of use.

In an extension of Mathieson' (1991) study, Taylor and Todd (1995a) compared the validity of TAM, TPB and a Decomposed TPB (DTPB) in predicting students' use of a university computer centre services (Table 1). In the DTPB model the key relationships of TPB are kept intact, and antecedents are introduced for attitudes (perceived usefulness, ease of use, compatibility), subjective norm (peer influence, superior influence), and perceived behavioural control (self-efficacy, resource facilitating conditions and technology facilitating conditions). The DTPB provides an integration of TPB with several key constructs from previous IS studies, namely TAM' perceived usefulness and perceived ease of use, Bandura' self-efficacy, and Triandis' facilitating conditions.

Beliefs, attitudes and intention were measured at the beginning of term, while usage was objectively monitored during the rest of the term. All paths were found to be significant except, for TAM, the path from attitude to intention. The insignificant influence of attitude is a contradiction to Mathieson' (1991) results, while it confirms suggestions that attitude is not an important determinant of use intention (Davis et al. 1989). The comparative test of TAM, TPB, DTPB indicated that overall, all three models performed quite well. While TAM had slightly less explanatory power than TPB or DTPB it has the advantage of simplicity. On the other hand Taylor and Todd

argue that TPB and the DTPB are richer in explaining which specific variables contribute to the use and intention, thus providing more effective prescriptions for managers.

The studies of Davis et al. (1989), Mathieson (1991), Taylor and Todd (1995a) were concerned with comparing the TRA, TAM, and the TPB to establish their relative validity in explaining IS usage. The main conclusion was that the three theories provide comparative levels of explanation, however, TAM fares better in terms of simplicity. Additionally, its inclusion of two standard constructs, PU and PEOU, makes it easier to apply in different settings and allow comparison and accumulation of research findings.

Davis (1989) examined the relationship between perceived usefulness, perceived ease of use and reported use. PU was found the only predictor of use (in study one and two), while PEOU was believed to influence usage indirectly through PEOU. Adams et al (1992) extended Davis (1989) to different IT context. The results of study "one" is consistent with those of Davis et al (1989) and Davis (1989). The results of study "two" shows that for word processing the path from PU to use is insignificant, while that from PEOU to use is significant. For spreadsheets, PU positively influenced use, while PEOU negatively influenced it. The results for Graphics indicated the importance of ease of use rather than PU.

Sjazna (1996) tested the revised TAM on a sample of undergraduate students in the context of an Electronic Mail (E-M) system. Findings showed that intention predicted usage pre- and post-implementation, with a stronger relation at post-implementation. PU was found to influence intention, however PEOU did not. Finally, PEOU was found to influence PU. Straub et al. (1995) tested TAM in the context of voice-mail system in one organisation. The construct of use intentions was excluded from TAM because the study was interested in explaining current use rather than predicting future use. The results showed that PU had a significant influence on self-reported use. While perceived ease of use had a positive influence on perceived usefulness, it had no effect on use. It was suggested that PU had mediated the influence of PEOU on usage. The last four studies; Davis (1989), Adams et al (1992), Sjazna (1996), and Straub et al (1995); are examples of various replications of TAM in different systems contexts (see table 3-1 for details).

Recently, researchers used a subset of Triandis' model (1980) to explain IS usage behaviour. Thompson et al. (1991) adapted the Triandis model to understanding the use personal computing. They hypothesised that affect of use, social factors, long term consequences of use, perceptions of computer job fit, and facilitating conditions positively influence PC usage, while perceptions of complexity of use is expected to negatively influence usage. The study excluded intention from the model because it focuses on explaining current use. Habits were also excluded due to the overlap between it and the operationalisation of current use. The definitions of affect, job fit and complexity are similar to TAM' definitions of attitude, perceived usefulness and perceived ease of use respectively, while the conception of facilitating conditions is close to that of perceived behavioural control introduced by the theory of planned behaviour.

Based on responses from 212 knowledge workers in a large multinational organisation, the data provided moderate support for the model, explaining 24% of the variance in usage. Social factors, long term perceived consequences and perceptions of the computer job fit were found to have a positive influence on use. Perceptions about complexity of use were found to have a negative influence on use, while affect and facilitating conditions were not found to influence usage. The analyses confirmed findings of previous research concerning the relative importance of PU and PEOU, as job fit was found to be more important than complexity in determining use. Also the insignificant influence of affect is consistent with prior results (Davis et al., 1989; Taylor and Todd, 1995a,b).

Bergeron et al. (1995) used the Triandis model (1980) to explain Executive Information Systems (EIS) usage. It covered 38 executive users from top and middle management in 9 enterprises. Usage was defined as: (1) the internalisation of EIS use (dependence on the system, ownership of the system, and routinisation of use) and (2) frequency of EIS use. Perceived consequences and affect (satisfaction with information, access, and assistance) were found to have a positive influence on internalisation of use. The positive impact of affect, in terms of satisfaction, detected in this study is inconsistent with results of other studies that used a simple good/bad definition of attitude (e.g., Davis et al., 1989; Thompson et al., 1991; Taylor and Todd, 1995a,b). This emphasises the need for a wider conceptualisation of attitude/affect in the explanation of IT usage.

Contrary to expectations, the presence of a hotline (a measure of facilitating conditions) was found to have a negative influence on EIS use. On the other hand, social factors and availability of EIS functions (another dimension of facilitating conditions) correlated positively with internalisation of use, however their influence were not significant in the regression analysis. The findings of Bergeron et al (1995) reaffirmed the importance of the constructs perceived usefulness and satisfaction in explaining EIS use. However, their study ignored an important technology related belief; perceived ease of use. It also does not go as far as to examine the external factors that may influence perceived consequences, the main determinant of EIS use. Additionally, the size and nature of the sample shadows the generalisation of the results.

Other researchers further extended the TRA and the TAM by incorporating constructs that showed consistent relationships with usage from the IS literature. For example, Lucas, Ginzberg, and Schultz (1990) used the TRA to combine some of the consistent relationships in systems success research into a two-stage model of IS implementation, the manager model and the user model. According to the user model, use is determined by "personal stake" (the degree to which the user believes that his future rewards are tied to the system and its use), personal (decision-style, demographics), task related (job characteristics), and system specific (knowledge, assessment, characteristics) factors. On the other hand personal stake is determined by user perceptions of top management support, user knowledge about the system, organisational change caused by the system, and the problem urgency.

Lucas et al. (1990) studied 600 users of a Decision Support System (DSS) in a large international firm. Personal stake was the only significant determinant of usage. Personal stake in turn was determined by perceptions of management support, problem urgency and extent of change required if the system is to be removed. In this study the model explained 5% only of the variance in the DSS usage. The mandated nature of use was the main reason presented for the weak results. A later survey (Lucas et al., 1990) in the same firm covered 142 planners who used the same DSS and other sources of information in a more voluntary fashion. Usage was defined as number of inquiries and self reported overall level of use. The model was unable to explain usage when measured in terms of number of inquiries, while it explained 52% of the overall usage with personal stake having the strongest influence on usage. This

lends significant support to the importance of this construct as a major determinant of systems use.

Hartwick and Barki (1994) incorporated the participation–involvement relationship into the theoretical framework of the theory of reasoned action. Participation in systems development was found to influence involvement (beliefs that the system is both relevant and important) and attitudes towards the system. Attitudes towards the systems were found to positively influence attitudes towards the use of the system, while involvement was found to positively influence subjective norm concerning use. Behavioural attitudes and subjective norm positively influenced intention to use, which in turn positively influence usage. Thus the results showed strong support for TRA. However, inconsistent with TAM (Davis et al, 1989) it highlighted the relevance and importance of subjective norm as an important determinate of IS usage. The difference in results could be attributed to the difference in the context and sample of the two studies (see Table 1).

Taylor and Todd (1995b) tested the validity of an augmented TAM in predicting the behaviour of experienced users compared to inexperienced users. Their model introduced subjective norm as a predictor of use intention besides attitudes and perceived usefulness. They also added perceived behaviour control as a potential determinant of usage beside intention. Generally, the model was capable of explaining the systems usage for experienced and inexperienced users. Consistent with prior studies, attitudes were not related to intention for the two groups. For the experienced group, the link between intention and behaviour was significantly higher than that for the inexperienced group. Subjective norm was found to have a significant influence on intention for inexperienced users while no such relation existed for experienced users

Using the TAM, TRA and the TPB as a theoretical reference Igbaria et al. (1995) investigated the influence of some external factors on usage of personal computers (Table 1). Their model didn't include behaviour intention in predicting use since it aimed at the explanation of use rather than predicting it. The results supported the influence of individual, organisational, and system characteristics on perceived ease of use and perceived usefulness. It also confirmed that PEOU determines PU, which in turn determines both perceived usage and variety of use. User training, computer experience, end user support, and system quality were found to directly influence

usage. This study shows the importance of external factors in explaining the general usage of personal computers.

In a later study, Igbaria et al (1997) expanded TAM by including two sets of external factors as potential determinants of PU and PEOU: (1) intra-organisational factors (internal computing support, internal computing training, and management support), (2) extra-organisational factors (external computing support, external-computing training). Based on a survey of 358 users of personal computers in small firms, the findings indicate that both PU and PEOU influence usage explaining 25% of its variance. However, inconsistent with previous findings, PEOU was found to be the dominant factor in explaining use. PEOU was found to strongly influence PU. Management and external support were found to influence perceived usefulness and perceived ease of use. Internal training was found to influence only PU and external training was found to influence only PEOU, while internal support showed no significant influence on either.

More recently, Malhotra and Galletta (1999) extended TAM to account for social influences (subjective norm). In their model the construct "psychological attachment" was hypothesised to positively influence behavioural intention and attitudes towards usage, while the other relationships of TAM remained contact. The results indicate that social influences have direct effects on attitudes, however they affect behaviour intentions only indirectly.

3.3.6 Evaluation of the IS Usage Theories

The constructs and the relationships suggested by the previously discussed models may be synthesised into three related levels of analyses. Firstly, on the level of the direct determinants of use, all the models included *Intention* as a direct determinant of use. For the TRA and the TAM, intention is considered the only direct determinant of behaviour. However, the TPB adds a second determinant in addition to intention, which is *Perceived Behavioural Control*. The Triandis' Model suggests a similar construct; named *Facilitating Conditions* in addition to another construct, *Habits*.

Secondly, on the level of the determinants of use intention, the following constructs are suggested: (1) *Attitude* (in terms of the TRA and TAM) or *Affect* (in terms of the Triandis' model). (2) *Subjective Norm* (in terms of the TRA) or *Social Factor* (in terms of the Triandis' model). (3) *Perceived Usefulness* (in terms of TAM) or

Perceived Consequences (in terms of the Triandis' model) (3) *Perceived Ease of Use* (in terms of TAM). (4) *Facilitating Conditions* (in terms of the Triandis' model) or *Perceived Behavioural Control* (in terms of the TPB).

Thirdly, on the level of the determinants of user perceptions, TRA, TPB and TAM recognise the influence of *External* variables (e.g., individual differences, organisational and environmental variables, beliefs related to systems). The first section of this chapter showed that numerous IS success factors could be seen as potential external factors that may have an impact on systems acceptance and user perceptions. Such acknowledgement of the role of external factors in determining behaviour provides theoretical foundation to incorporating important success factors from the literature concerned with IS implementation. Additionally, a better understanding of the role of external factors will enable practitioners to build strategies that could help improve the acceptance of newly introduced system and provide diagnostic tools to promote the acceptance of existing ones by prescribing different strategies for manipulating different user perceptions.

Further, despite the substantial empirical evidence suggesting that user perceptions are important determinants of systems use, there is considerably less work in the area of examining what factors influence user perceptions (e.g., Agarwal and Prasad 1998; Davis and Venkatesh, 1996; Igbaria et al, 1995; 1997). It is important, however, to note that the influence of external factors on behaviour is not expected to hang consistently across situations as in the case of the main construct; beliefs, attitudes, subjective norm, and perceived behavioural control.

Table 3-1 depicts a summary of some of the findings concerning the empirical validity of the four behavioural models. It helps clarify the key determinants of use that showed consistent direct and/or indirect influence on usage. From the table it could be noted that all of the models showed the ability to explain system usage. Perceived usefulness (consequences, personal stake, outcome expectation), perceived ease of use (complexity, self efficacy), attitude (affect), perceived behavioural control, facilitating conditions, subjective norm, and use intention are all found to be important determinants of the IS usage behaviour.

Despite that intention to use appears to predict use behaviour quite accurately, when the main emphasis of the study is to merely understand reported behaviour, it is not

meaningful to claim that a person performed a certain behaviour because he has the intention to do so. In such case intention has no explanatory value and could be excluded from the explanation of behaviour (Ajzen, 1988). Since use intention does not provide much information about the reasons for the use behaviour it was excluded from the usage models of many prior studies (e.g., Bergeron et al. 1995; Igbaria et. al., 1995; 1997; Matheison et.al, 1991).

The **Theory of Reasoned Action** was proven to be a robust and powerful model as demonstrated by the results of two meta-analysis of 85 studies that applied TRA to various behaviours and contexts (Sheppard et al., 1988). Moreover, the strong convergence in the findings of the studies that applied TRA in IS settings shows that its factors are quite powerful in predicting and explaining IT usage behaviour. TRA also encompasses many of the variables that has been studied by IS researchers. For example top management support and the existence of a champion that have been found influential in systems success, especially that of EIS, are submitted under the subjective norm in TRA. Important success factors such as the quality of the user interface (ease of use), outcome attitudes (usefulness) are reflected through the attitude construct (Barki and Benbasat, 1996).

The **Theory of Planned Behaviour**'s additional construct of perceived behavioural control is closely related to that of ease of use (Davis, 1989), Bandura's (1977) concept of self-efficacy, and the notion of facilitating conditions (Triandis, 1979). Perceived behavioural control also relates to issues concerning user training and the availability of technology (Taylor and Todd, 1995b). This combined with Mathieson's (1991) direct test of the theory of planned behaviour in explaining use intention highlights its relevance in IS contexts.

Although the **Triandis' model** was recently used for the study of IT acceptance, the empirical evidence show that it is capable of explaining the individual usage of personal computing (Thompson et. al, 1991, 1994) as well as the usage of executive information systems (Bergeron et al, 1995). These findings reaffirm the importance of factors such as perceived consequences (PU) and social factors (SN) and in the meantime highlight the importance of the facilitating conditions as an important determinant of IT use.

The **Technology Acceptance Model** was found to be much simpler, easier to use and a powerful model of the determinants of IT use. When compared to TRA and TPB it explained equal amounts of the variance in use with fewer variables. TAM' s two constructs, PU and PEOU, are found to be central in the explanation of IT usage. The availability of well tested and validated context free instruments to measure PU and PEOU, makes it easier to apply TAM in different IS settings and allows comparison and accumulation of research findings.

Overall TAM have shown significant empirical validity in different IT contexts (table 1). It was originally tested in the context of simple IS applications such as e-mail and graphics (Davis, 1989). It was then extended to voice mail and word processors (e.g., Adams et al., 1992; Chau, 1996), spreadsheets (Mathieson, 1991; Adams et al, 1992; Chau, 1996), and group support systems (Chin and Gopal, 1993). This makes it a practical and useful tool to researchers interested in examining the acceptance/utilisation of multiple classes of information technology applications across organisations. It is worth noting, however, that no prior studies applied TAM in the context of executive information systems (EIS).

In no case does one model purport to explain the entire process of information systems utilisation and TAM is no exception. Hartwick and Barki (1994), Taylor and Todd (1995a), and Malhotra and Galletta (1999) indicated that excluding subjective norm could weaken TAM' s explanatory and predictive power because it ignores the role of social influence in the acceptance of IT. Moreover, previous studies suggested that TAM's ability to explain systems usage could be enhanced by extending it to include other important usage determinants from the IS literature (Taylor and Todd, 1995b). Additionally, more research is invited to extend TAM by identifying external factors that could be potential determinants of user perception (Igbaria et al, 1995).

Based on the above discussion of usage models, the technology acceptance model appears as an appropriate theoretical base for the EIS usage model proposed in this study. However, to achieve a more complete understanding of EIS use, TAM needs to be integrated with key constructs from other behavioural models and external factors found consistently important in explaining IS/EIS success. It is hoped that integrating related models will help researchers develop a more complete understanding of the factors related to IS/EIS usage as well as allowing the comparison and accumulation of research findings.

3.4 Conclusion:

This chapter discussed two influential research streams in the area of information systems utilisation. The models in the first stream study usage as a criterion of implementation success or as part of the final stage in the IS implementation process. These models provided the bases for deriving research hypotheses that guided the work of numerous empirical studies. The main criticism directed to the factor and process studies was the lack of common foundation theories, the inclusion of a large number of factors that were weakly related and poor attention to construct measurement.

The second research stream covers theories from social psychology more recently used to explain and predict the behaviour of IT usage. These theories are the theory of reasoned action, the theory of planned behaviour, the Triandis' model of attitude and behaviour, and the technology acceptance model. Their main advantage is that they suggest a cohesive set of constructs that influence IT usage. In the mean time they allow the inclusion of key success factors from the IS literature as external variables. They are also particularly suitable to explain voluntary behaviours and are thus suitable to the explanation of the use of EIS use, which is generally voluntary (Lucas, 1994).

The chapter then reviewed some of the key work that has applied the TRA, the TPB, the Triandis' model, and the TAM to the study of IT usage. Empirical evidence showed that although all of the models are useful in explaining the IS usage behaviour, TAM is much simpler and easier to use. However to provide a more complete understanding of the important determinants of IS/EIS use, TAM needs to be integrated with key constructs from the IS/EIS literature. The next chapter starts with discussing the rationale behind the integrated EIS use model proposed by this study. The research model is then presented followed by a comprehensive survey of the literature relevant to its individual hypotheses.

Table 3-1 Empirical evidence concerning IS usage models

Study	Methodology	Theoretical Foundation	IT Type	Independent Variable	Dependent Variable	Influence	Variance
Adams et al., 1992 Study 1	Survey of 118 users from 10 organisations	TAM	E-M	PU PEOU	Use	Positive NS	15.5%
			V-M	PU PEOU	Use	Positive NS	17%
Adams et al., 1992 Study 2	Survey of 73 users in one university	TAM	Word processing	PU PEOU	Use	NS Positive	4%
			Spreadsheets	PU PEOU	Use	Positive Negative	35%
			Graphics	PU PEOU	Use	NS Positive	29%
Bergeron et al, 1995	Survey of 38 managers from 9 organisations	Triandis' Model	Executive Information Systems	Consequences Affect Presence of hotline Workplace influence EIS sophistication EIS experience	Internalisation of EIS Use	Positive Positive Negative NS NS NS	51.8%
				Consequences Affect Presence of hotline Workplace influence EIS sophistication EIS experience	Frequency of EIS Use	NS Positive NS NS NS NS	11.4%
Davis,1989 Study1	A study of 112 users in one organisation	TAM	E-M	PU PEOU	Use	positive NS	31%
			X-Edit	PU PEOU	Use	positive NS	46%

Table 3-1 continued

Study	Methodology	Theoretical Foundation	IT Type	Independent Variable	Dependent Variable	Influence	Variance
Davis, 1989 Study 2	40 inexperienced users from one University	TAM	Chart-Master	PU PEOU	BI BI	Positive NS	51%
			Pen-Draw	PU PEOU	BI BI	Positive NS	71%
Davis et al, 1989: After One Hour Introduction)	Longitudinal study (107 MBA student)	TAM	Word-One	BI	Use	Positive	12%
				A PU	BI BI	Positive positive	47%
		TRA		BI	Use	Positive	12%
				A SN	BI BI	Positive NS	32%
After 14 Weeks of Availability		TAM		BI	Use	Positive	40%
				A PU	BI BI	NS Positive	51%
		TRA		BI	Use	Positive	40%
				A SN	BI BI	positive NS	26%
Hartwick & Barki (1994) Pre-Implementation	Longitudinal study (105 users/ 130 organisations	TRA	New Information Systems	BI	Use	Positive	35.2%
				A SN	BI BI	Positive Positive	70.4%
Post-Implementation				BI	Use	Positive	73.8%
				A SN	BI BI	Positive NS	80.8%

Table 3-1 continued

Study	Methodology	Theoretical Foundation	IT Type	Independent Variable	Dependent Variable	Influence	Variance
Igbaria et al. (1995)	Field Study in One University (214 Part Time Student mostly Full Time Workers	TAM, TRA, and TRA	Use of PCs	Training Experience EUC support Management support Systems quality PU PEOU	Perceived Use	Positive Positive Positive Positive Positive Positive NS	31%
				Training Experience EUC support Management support System Quality PU PEOU	Variety of Use	Positive Positive Positive NS NS Positive Positive	45%
Igbaria et al, 1997	A survey of 596 users from 504 small firms	TAM	PC use	PU PEOU	Usage Usage	Positive Positive	25%
				PEOU Internal support Internal training Management support External support External training	PU	Positive NS Positive Positive Positive Positive	30%
				Internal support Internal training Management support External support External training	PEOU	NS NS Positive Positive Positive	4%

Table 3-1 continued

Study	Methodology	Theoretical Foundation	IT Type	Independent Variable	Dependent Variable	Influence	Variance
Malhotra and Galletta, 1999	208 potential users of a US healthcare organisation.	TAM	A Group-Ware package	BI	Use	Positive	49.7%
				PU A SN	BI	Positive Positive NS	41.5%
				PU PEOU SN	A	Positive Positive Positive	33.7%
Mathieson, 1991	Lab. Experiment University (139 students)	TAM	Spreadsheet or calculator	A PU	BI BI	Positive Positive	69.3%
		TPB		A SN PBC	BI BI BI	Positive NS Positive	60.1%
Sjazna, 1996 Pre-implementation	Longitudinal study University (61 students)	TAM	E-M	BI	Use	Positive	8%
				PU PEOU	BI	Positive NS	52%
Post-implementation				BI	Use	Positive	32%
				PU PEOU	BI PEOU	Positive positive	10% 8%
Straub, et al. 1995	Study of 485 users in one organisation	TAM	V-M	PU PEOU	Use Use	Positive NS	48%

PU = Perceived Usefulness
PEOU Perceived Ease Of Use
PBC = Perceived Behavioural Control
A = Attitude
BI = Behavioural Intention
NS = Not Significant

Table 3-1 continued

Study	Methodology	Theoretical Foundation	IT Type	Independent Variable	Dependent Variable	Influence	Variance
Taylor & Todd, 1995b Experienced group	Longitudinal Study on One University (786 students)	Augmented TAM	Computer-Centre	BI PBC A SN PBC PU	Use Use BI BI BI BI	Positive NS NS Positive Positive Positive	21%
Inexperienced group				BI PBC A SN PBC PU	Use Use BI BI BI BI	Positive Positive NS Positive Positive Positive	17%
Taylor & Todd, 1995a	Longitudinal study University 786 students	TAM	Computer centre services	BI PU A	Use BI BI	Positive Positive NS	34%
		TPB		BI PBC A SN PBC	Use Use BI BI BI	Positive Positive Positive Positive Positive	34%
Thompson et al, 1991	Large Multi-National organisation, 212 workers	Triandis' Model	PC use	Social Factors Affect Complexity Job-fit Long consequences Facilitating conditions	Usage	Positive NS Negative Positive Positive NS	24%

Chapter 4

Research Model and Hypotheses

4.1 Introduction

The previous chapter introduced a review of the theoretical and empirical literature related to the determinants of information systems use. The evaluation of some of the key IS usage models provided strong support to the validity of the technology acceptance model in different information systems contexts. However, previous studies suggested integrating TAM with other constructs from the IS literature to increase its explanatory power (e.g., Taylor and Todd, 1995b and Venkatesh, 1999). They also emphasised the need to extend TAM to explain user perceptions by including relevant external factors into its theoretical framework (Davis et al, 1989; Agarwal et. al., 1996).

This chapter presents the model of EIS usage proposed by this study. The proposed model integrates the technology acceptance model (TAM) with constructs from the theory of reasoned action (TRA), the theory of planned behaviour (TPB), the Triandis' model, and IS/EIS implementation success literature. It is expected that such an integrated model will provide a more complete picture of the determinants of the use of EIS. The chapter starts with a discussion of the rationale behind the development of the research model. The proposed model and hypotheses are then introduced together with a survey of the theoretical and empirical literature relevant to each of its hypotheses.

4.2 The Rationale behind the Research Model

The research model proposed in this study integrates TAM with constructs from other behavioural models and IS/EIS implementation research. According to TAM, behavioural intention is the only direct determinant of usage. However, as the main objective of this study is to understand the utilisation of EIS rather than to predict future usage, intention has no explanatory value and could be excluded from the model. This decision is consistent with the work of Thompson et al (1991) and Bergeron et al (1995).

The research model proposes that, in addition to TAM's perceived usefulness and perceived ease of use, EIS use is determined by perceived information quality,

subjective norm, and facilitating conditions. Because of the weak empirical support to the relationship between attitude measured on a good/bad scale, and usage (e.g., Davis et al., 1989; Thompson et al, 1991, Taylor and Todd, 1995a, b), researchers suggested the use of a wider conceptualisation of attitude, namely user satisfaction, from the IS literature. The review of literature on user satisfaction reveals that this construct was studied from three perspectives: attitudes toward MIS, information quality, and effectiveness (Kim, 1989). One of those dimensions, information quality, was found to be of great importance for the success of EIS (e.g., Bergeron et al, 1995; Leidner, 1996; Koh and Watson, 1998; Rainer and Watson, 1995; Rockart and Delong, 1988). Thus *EIS information quality* was included in the proposed model as a direct determinant of EIS use.

Several researchers (e.g. Davis et al, 1989; Malhotra and Gattetta, 1999; Venkatesh and Morris, 2000) noted that TAM is incomplete in that it leaves out the role of social factors. Rockart and Delong (1988) underscore the importance of the availability of an executive sponsor to the success of EIS. Also the results of a more recent survey of EIS key success factors found top management support to be high on the list of EIS key success factors (Rainer and Watson, 1995). While a system may be believed to be useful and easy to use, prevailing subjective norm may not support its use. Thus, adding the construct of *subjective norm* to TAM is expected to improve the understanding of EIS utilisation.

TAM is also limited in that it does not recognise circumstances when the behaviour is believed to be useful and easy to perform, yet not undertaken due to lack of conditions that makes it possible (Compeau et al, 1999). The proposed model thus includes the construct *facilitating conditions* that covers the factors that may encourage or impede the usage of the system. This factor was suggested by other behavioural theories (Triandis, 1980; Ajzen, 1991) to directly influence behaviour. Availability of EIS functions, such as status access, exception reporting, and drill down, was highly ranked as key to the continuation of the EIS use (Rainer and Watson, 1995). This may be due to increasing the ability of the EIS to fit the demands of the highly variable executive work styles and environments (Rockart and Delong, 1988).

Consistent with the work of Hartwick and Barki (1994) and the recommendations of Taylor and Todd (1995b) the research model includes *user involvement* as a direct determinant of EIS use. This addition integrates TAM with an important line of

research in the IS literature which related user participation in the system development to usage through the intervention of a need-based psychological component, that is user involvement (McKeen et al, 1994). Moreover Rainer and Watson (1995) found that executive involvement in EIS development process is of paramount importance for the systems success.

Although there is a substantial body of evidence linking perceived usefulness to systems use, there is considerably less work directed to the investigation of the determinants of such important perception. TAM hypothesises that perceived of ease of use is the only determinant of perceived usefulness. Thus, the research model suggests that in addition to perceived ease of use, EIS perceived usefulness is influenced by perceived information quality, user involvement, subjective norm concerning EIS use and facilitating conditions.

The technology acceptance model suggests that external factors influence IT usage indirectly through user beliefs (Davis et al. 1989). Several external factors were included in TAM since Davis et al's (1989) recommendation for external factors to be investigated in future studies. The review of relevant literature reveals numerous potential external factors such as user characteristics, system features, organisation context variables (Kraemer and Dutton, 1991, Kwon and Zmud, 1987; Rainer and Watson, 1995; and Swanson, 1988). The incorporation of all those factors in a single testable model is practically impossible.

Thus, the proposed model includes into TAM four constructs as *external factors*. Those are (1) MIS organisational maturity, (2) user participation in EIS development, (3) computer training, and (4) user experience. The approach used for building the EIS usage model proposed by this study is believed to allow systematic integration of past IS research within one of the widely accepted theoretical foundations, the technology acceptance model. The following section presents a detailed account of the research model and its associated hypotheses.

4.3 The Research Model and Hypotheses:

Figure 4-1 depicts the EIS use model proposed in this study. According to the model, EIS usage is determined by perceived usefulness, perceived ease of use, perceived information quality, involvement, subjective norm, and facilitating conditions. Perceived usefulness is in turn determined by perceived ease of use, information

quality, subjective norm, facilitating conditions, and involvement. The research model also hypothesises that perceived ease of use, information quality, and involvement are determined by information systems organisational maturity, participation, computer training, and user experience.

Following is a discussion of the literature review concerning the relationships included in the research model. Firstly, the main dependent variable in the proposed model, that is EIS usage, is defined, and then the theoretical and empirical foundation of each of the research hypotheses is presented.

4.3.1 EIS Use

Information systems use is defined as the "the recipient consumption of the out put of an information system" (Delone and Mclean, 1989). Systems usage is one of the most popular surrogates of information systems success in conceptual frameworks (e.g., Ein-Dor and Segev, 1978; Zmud, 1979; Ives, Hamilton and Davis, 1980) and empirical studies (e.g., Lucas, 1975; Culnan, 1983; Srinivansan, 1985; Straub et. al. 1995; Sjazna, 1996). Understanding the determinants of systems use is also of notable practical value for managers interested in evaluating the impact of IT (Straub et. al., 1995). From a practical point of view, usage is a necessary condition for any performance gains from IT. Especially in a computing environment driven by voluntary users, such as that of EIS, usage becomes an appropriate indicator of systems success (Lucas et. al., 1990).

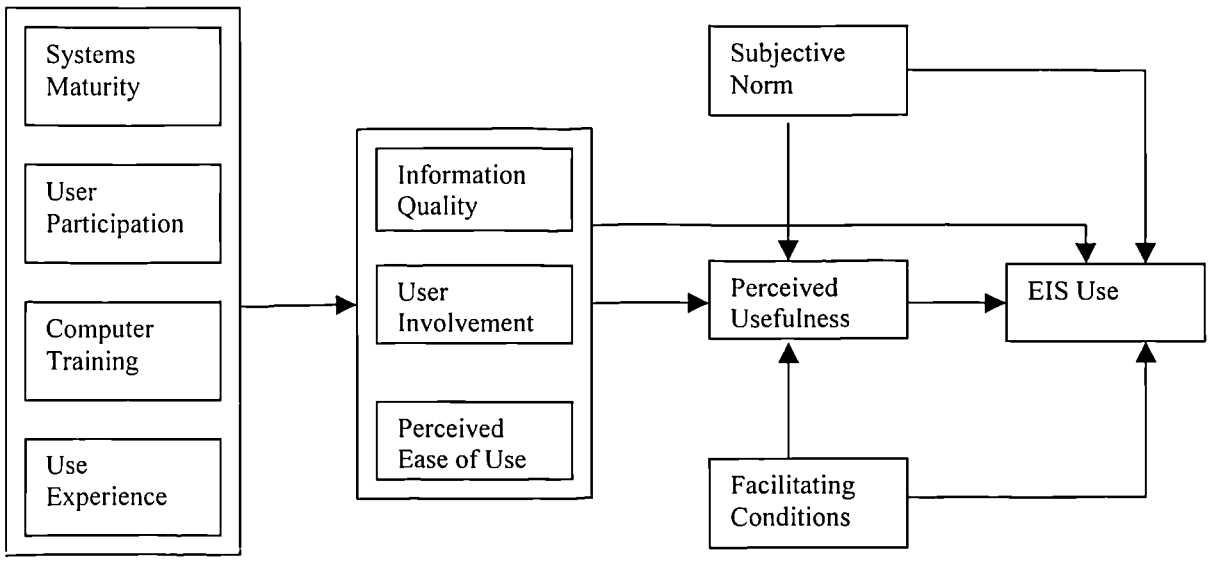


Figure 4.1 The Integrated Model of EIS Use

Systems usage can mean "any use" as opposed to "no use" or the "degree of use". Because EIS is considered one of the many information sources available to managers to support their work activities, it is expected that there will be variations in the extent to which managers use this source. Therefore, this study will conceptualise EIS use in terms of degree of use.

Another important issue, rarely considered explicitly in the IS usage research, is the direct and indirect modes of use. Despite that EIS are mainly hands-on use systems, many effective systems are still chauffeur driven (Levinson, 1984). It is argued that a lot of executives have their assistants use the EIS (Bartholomew, 1997). However, managers do not choose between the on-hands use and use of the system by the means of an intermediary, rather managers may be active in both roles (Swanson, 1988). Thus, this study conceptualises usage to include both direct and indirect modes of use.

4.3.2 Perceived Usefulness (PU):

Perceived usefulness is defined as "the degree to which the person believes that using a certain technology will enhance his or her performance" (Davis, 1989 p. 320). The work of Schultz and Slevin (1975) has underlined the strong impact of perceived usefulness on systems usage. They conducted an exploratory factor analysis of 67 questionnaire items, which yielded seven dimensions. Of these, the "performance" dimension interpreted by the authors as the " perceived effect of the model on the manager's job performance" was most highly correlated with the intended use of a decision model. Using Schultz and Slevin (1975) instrument, Robey (1979) found that the performance dimension is the most correlated factor with systems use.

Also the social cognitive theory recognises the importance of outcome related beliefs on behaviour (Davis, 1989). Additionally, perceived usefulness is very similar to the notion of perceptions of relative advantage from the adoption of innovation theory (Moore and Benbasat, 1991). The influence of perceived usefulness on usage is supported by numerous empirical studies (e.g., Adams et al, 1992; Gefen and Straub, 1997; Igbaria et al, 1995; 1997). Personal stack, a construct compatible with PU, showed a strong positive influence on DSS use (Lucas et al, 1990). Also perceived consequences, a synonym of perceived usefulness, was found to have a significant influence on the use of executive information systems (Bergeron et al., 1995) and on use of personal computers (Thompson et al., 1991).

The technology acceptance model, the theory of reasoned action, and the Triandis' model theorise that perceived usefulness is an important determinant of usage. This relationship is based on the reinforcement value of the behaviour outcomes. Moreover the impact of EIS on the performance of executive work was highly ranked as key to the ongoing success of EIS (Watson et al, 1997). Thus, this study expects that executives will tend to use EIS to the extent they believe it will help them improve their work performance. Therefore, the following hypothesis is proposed.

H1: Perceived usefulness positively influences use.

4.3.3 Perceived Ease of Use (PEOU):

Perceived ease of use is defined as "the degree to which a person believes that using a certain system is effort free" (Davis, 1989, p.320). The concept of ease of use is similar to that of self-efficacy, "judgement of how well one can execute courses of action required to deal with prospective situations" (Bandura, 1982, p. 122 in Davis, 1989). Vankatesh and Davis (1996) reported that Hill, Smith, and Mann (1987) operationalised self-efficacy similar to perceived ease of use. The definition of PEOU is also echoed in the adoption of innovation notion of complexity, where innovations that are perceived to be easier and less complex have higher chances of being accepted and used by potential users (Moore and Benbasat, 1991).

The role of ease of use was also recognised by past research on the evaluation of information sources. O'Reilly (1982) investigated the impact of accessibility vs. quality of information on the use of alternative information sources. He found that decision-makers made more use of low quality information sources that were more accessible. This was attributed to the user's trade-off between high quality information sources and the effort needed to access those sources. Thus, given that users believe that a system is useful, they may also believe that it is too hard to use and that the performance benefits of usage are outweighed by the effort invested in using the application. Thus in addition to usefulness, usage is theorised to be influenced by perceived ease of use.

The results concerning the influence of PEOU on usage are mixed. Davis et al. (1989), Davis (1989), Straub et.al (1995), Adams et al (1992, study one), and Sjazna (1996) found PEOU to have no significant influence on usage because PU mediated its influence. On the other hand, Igbaria et al. (1997) found perceived ease of use to

be the major determinant of personal computer use. Adams et al (1992) found, in his second study, that perceived ease of use has a significant positive influence on use. Gefen and Straub (1997) also reported that PEOU of e-m has a significant influence on use. Further Mathieson (1991) found perceived ease of use to be a direct determinant of use intention. Thompson et al. (1991) reported that perceived complexity of use i.e. opposite of perceived ease of use, has a negative influence on the use of personal computers. Also computer self-efficacy, a construct compatible with PEOU, positively influenced computer usage (Compeau and Higgins, 1995).

Perceived ease of use was also found to explain a considerable variance in perceived usefulness (Mathieson, 1991; Sjazna, 1996; Adams et al, 1992; and Igbaria et al, 1997). Also computer self-efficacy was found to explain perceived consequences of computer usage (Compeau and Higgins, 1995). These findings suggest that perceived ease of use is an important determinant of perceived usefulness.

According to the technology acceptance model perceived ease of use influences usage directly, and indirectly though its influence on perceived usefulness. Moreover the theory of planned behaviour proposes that perceived behavioural control i.e. perceived ease or difficulty of the behaviour, has a direct positive influence of behaviour (Ajzen, 1988). Based on the previous evidence, the following hypotheses are proposed.

H2.1: Perceived ease of use positively influences use.

H2.2: Perceived ease of use positively influences perceived usefulness.

4.3.4 Perceived Information Quality:

Perceived information quality is defined as "the extent to which users believe that the information systems available to them meet their information requirements in terms of timeliness, accuracy, format, and relevance of the information generated by the system" (Seddon and Kiew, 1994; Leidner, 1996). The direct link between different facets of user satisfaction and usage is supported with a big body of empirical research (e.g., Baroudi et al, 1986; Ein-Dor and Segev, 1986; Elkordy, 1994; Lucas, 1975, 1978; Robey, 1979; Raymond, 1985; O'Reilly, 1982; Torkzadeh and Dwyer, 1994).

Many of the prior studies (e.g., Davis et al, 1989; Taylor and Todd, 1995a,b; Thompson et al., 1991) measured attitudes following Fishbein and Ajzen's (1975) suggestions, by locating the person's position on a bipolar good/bad dimension. However, the evidence concerning the influence of attitude on use and use intention were weak. Researchers have thus recommended the use of a wider conceptualisation of attitudes, namely, user satisfaction (Taylor and Todd, 1995 a b; Thompson et al., 1991).

Following this suggestion, Bergeron et al (1995) defined affect towards EIS in terms of the user satisfaction with the EIS information quality, accessibility and services provided by the EIS staff. Their study found that affect of EIS has a positive influence on its use. This result is consistent with a prior study which found that the quality of the EIS information output is ranked as the most important characteristic of an executive information system (Bergeron et al, 1991). Also Leidner (1996) found that frequency of EIS use was best explained by the quality of the EIS information.

Perceived information quality was also related to perceived usefulness. Franz and Robey (1986) included dimensions of information quality in their instrument of perceived usefulness, which implies that they think the two constructs are highly related. Seddon and Kiew (1994) found that information quality of an accounting information system is a major determinant of its perceived usefulness. Also results from a survey of 211 operation managers in the public sector found that information quality has a positive significant influence on perceived usefulness of computer-based information (Kraemer et al., 1993).

The inclusion of information quality as a direct determinant of use in addition to perceived usefulness and ease of use is based on the Delone and Mclean (1989) model of IS success which proposes that information quality is a direct antecedent of systems use. Further, the extended Delone and McLean model of IS success (Seddon, 1997) proposes that information quality is a direct determinant of perceived usefulness. Also TAM and TRA imply that beliefs about systems quality, is expected to influence perceived usefulness. Thus the following hypotheses are proposed:

H3.1: Information quality positively influences use

H3.2: Information quality positively influences perceived usefulness

4.3.5 User Involvement:

In this study user involvement refers to a subjective psychological state of the individual rather than a set of activities during the development of the system. For many years IS researchers used the term involvement to refer to the physical participation in the systems development activities. Only recently has the distinction between involvement and participation been acknowledged by IS researchers (Barki and Hartwick, 1989). Following Barki and Hartwick (1989) involvement is defined as "the degree to which the user believes that the system possesses two characteristics: relevance and importance".

Swanson (1974) was the first to propose that IS appreciation co-produces inquiry involvement or system use. Kappelman and McLean (1991) argue that when user participation behaviours were studied in combination with user need-based attitudes or involvement, the relationship between user participation and system success/usage was found to be stronger than when researchers considered only user participation. Thus involvement is suggested to mediate the influence of participation on systems use.

Javenpaa and Ives (1991) reported a positive influence of executive involvement on the progressive use of IT in the organisation. Additionally, Hartwick and Barki (1994) embedded user involvement (system belief) into the theory of reasoned action to mediate the influence of participation in the systems development on its use. Seddon and Kiew (1994) argue that higher levels of user involvement are likely to lead to higher perceptions of usefulness, similarly, a system which is seen to be unimportant and irrelevant to the person, stands little chance of being perceived as useful. Larcker and Lessig (1980, p123) hold similar views as they suggest that perceived importance of an information set; defined as: the quality that causes a particular information set to acquire relevance to the decision-maker, will "tend to increase the perceived usefulness of the set".

Few studies have directly tested the influence of user involvement on perceived usefulness of information systems. One study (Seddon and Kiew, 1994) found user involvement to be an important determinant of perceived usefulness. Hartwick and Barki (1994) also reported a positive influence of user involvement on behavioural attitudes that included measures of perceived usefulness. These results imply that

higher levels of user involvement with an information system are likely to lead to higher perceptions of its usefulness.

Taylor and Todd (1995b) and Igbaria et al (1997) recommended the inclusion of involvement in future IT use models. Hartwick and Barki (1994) argue that user involvement is considered a belief about the attributes of the system not the behaviour of using it, however, he expected that the two will be related. Thus according to the technology acceptance model involvement is likely to be an antecedent to perceived usefulness. Therefore, the following hypotheses are proposed.

H4.1: Involvement positively influences use

H4.2: Involvement positively influences perceived usefulness

4.3.6 Subjective Norm:

Subjective norm is defined as "the person's perception that most people who are important to him think he should or should not perform the behaviour in question" (Fishbein and Ajzen, 1975, p.302). It thus reflects the social pressure to use the system. Subjective norm also corresponds to top management support and the existence of a champion that have been found influential in IS/EIS success (Igbaria et. al. 1997; Lucas et. al., 1990; Watson et al, 1997; Yap et. al 1992). The influence of an important referent group; that is top management, was reported to promote greater systems use (e. g., Lucas et. al., 1990; Lucas, 1978; and Robey, 1979).

Work group influence defined as the opinions of superiors, subordinates and peers was found to influence the use of EIS (Bergeron et. al, 1995). Also social influences concerning EIS information retrieval behaviour was positively related to the degree of performing that behaviour (Vandenbosch and Huff, 1997). Thompson et al (1991) found social factors to have a positive influence on the use of personal computers. Also use voluntariness defined as the extent to which potential adopters perceive the adoption decision to be non-mandated, had a negative influence on use intentions (Agarwal et al., 1996).

On the other hand Davis et al. (1989) and Mathieson (1991) did not find significant support to the relation between subjective norm and use, however, both studies used students as subjects. While, Vankatesh and Morris (2000) found that the influence of subjective norm on use intention diminishes over time. This implies that in organisations, superior /subordinate and peer group relationships are expected to

foster the normative influence and that as users gain experience with the system, their behaviour get less influenced by the opinions of others.

Prior studies suggest that individual perceptions about media use in the work place are socially constructed (Fulk et al., 1987). Social factor, defined as encouragement of important others, was found to influence beliefs of outcome expectations of computer use (PU) and beliefs of self-efficacy (Compeau and Higgins, 1995). Further, SN was a direct determinant of attitudes toward the use of IS which included believes concerning the system's usefulness (Hartwick and Barki, 1994). Also Igbaria et al (1995, 1997) findings support the existence of a direct positive relationship between top management support and perceived usefulness.

These findings indicate that social influences experienced by users may be related to usage and perceived usefulness. Additionally, the theory of reasoned action, the theory of planned behaviour, and the Triandis model, suggest that subjective norm will directly influence usage. Therefore, the following hypotheses are proposed.

H5.1: Subjective norm positively influences use

H5.2: Subjective norm positively influences perceived usefulness

4.3.7 Facilitating Conditions:

According to Triandis (1979) facilitating conditions is defined as "objective factors in the environment that can make an act easy or difficult to do". In the context of personal computing acceptance, facilitating conditions are seen as the extent of personal computing support provided to the user (Amoroso 1988; Amoroso and Cheney, 1991; Bergeron et. al., 1995; Igbaria et. al. 1997; Thompson et.al, 1991). It is also seen as the technological sophistication of the system (Cheney and Dickson, 1982; Raymond, 1990; Bergeron et al, 1995). Research findings suggest that user computer support positively influence systems success. However, Bergeron et.al (1995) reported a negative relation between systems support (availability of hot line) and use. Thompson et al (1991) also reported similar results. These findings imply that higher levels of support reported by the users might reflect a problematic system and thus it was associated with lesser use.

In their survey of executive information systems success factors, Rainer and Watson (1995) reported that the availability of EIS capabilities/functions is highly ranked as key to the continuing use of EIS. It could be argued that providing the user with more

features in the EIS increases the capability of the system to serve more different managerial roles and activities and is thus conduit to more use and higher perceived usefulness. The study of Bergeron et al (1995) found that facilitating conditions, defined as the availability of different EIS features, is positively related to EIS usage. Raymond (1985) also found that the number of applications provided to the user is positively related to systems usage and satisfaction.

On the other hand, as the managerial activities and roles vary, it is expected that an EIS which address a greater number of the executive problems (through the availability of more functions) will be perceived as being more useful and will be used more than a less sophisticated system. Based on the Triandis' model (1980) facilitating conditions is expected to directly influence the extent of usage. TAM also proposes that systems characteristics will influence use indirectly through their influence on perceived usefulness. Thus the availability of features in the system is also expected to influence perceived usefulness. The rational of this relation is that functionality of the system influences its effective usability and consequently its perceived usefulness (Goodwin, 1987). Therefore, the following hypotheses are proposed.

H6.1: Facilitating conditions positively influences use

H6.2: Facilitating conditions positively influences perceived usefulness

4.3.8 External Factors:

According to the technology acceptance model external factors are expected to influence systems use indirectly through beliefs (Davis et. al. 1989). Although there is a substantial body of evidence suggesting that user perceptions are important determinants of systems use, there is considerably less work in the area of examining what influences user perceptions (Agarwal et. al., 1996; Igbaria et al, 1995; and Venkatesh and Davis, 1994). This study focuses on exploring the impact of four external factors, namely participation, maturity of organisational IS, computer training, and user experience on perceptions of information quality, user involvement, and ease of use.

4.3.8.1 User Participation:

Participation refers to "a set of behaviours or activities performed by the potential users or their representatives during the system development process" (Barki and

Hartwick, 1989). Some researchers use the term involvement to refer to the user participation in the systems development activities (e.g., Torzadeh and Dwyer, 1994). User participation in the development of information systems is broadly accepted as one of the key determinant of information systems success (e.g., Baroudi, et al, 1986; Edstroom, 1977; Franz and Robey, 1986; Kim and Lee 1986; Yap et al, 1992). In the context of EIS, user participation is reported to increase the chances of user acceptance and successful implementation because it helps tailoring the system to meet users' perceptions (Watson et al, 1997).

Kappelman and McLean (1991) argue that the traditional model of information systems development and IS success is represented by a direct causal relationship between participation (a behaviour) and IS success (use and satisfaction). However, empirical evidence of this relationship is far from consistent. In their comprehensive review of the past research on user participation and IS success (1959-1981), Ives and Olson (1984) found that only 8 studies out of 22 reported a positive relation, while 14 studies found mixed or insignificant results. A follow up literature survey (1982-1992) reached a similar conclusion with 10 studies out of 23 reporting positive relation and 13 reporting insignificant relationship (Lei, 1994). Because those studies did not show much predictive power, Kappelman and McLean (1991) proposed a refinement to the original model which proposes a behavioural (participation) and an attitudinal (involvement) component for explaining the impact of user participation on information systems success. According to this model participation would influence usage indirectly through user involvement.

Swanson (1974) proposed and provided empirical evidence that a-priori involvement (participation in system development) co-produce IS appreciation. Thus managers who participate in the system development are expected to become more appreciative of the system. Javenpaa and Ives (1991) investigated the relationship between the top executive participation i.e. the CEO' activities or substantial personal interventions in the management of IT, and executive involvement i.e. the degree to which the CEO views IT as important and relevant to the organisation's success. The results found that CEO' participation has a significant positive influence on executive involvement.

Hartwick and Barki (1994) propose that user participation influences use indirectly through its direct influence on involvement and attitude. They employed the theory of reasoned action to describe the relation between participation, involvement, attitude

and usage of a new system. Three dimensions of participation (user-IS-relationship, responsibility, and hands-on activities) were hypothesised to influence user involvement and user attitudes. Their findings show that user participation has a positive effect on involvement and user attitude towards the new system. Further, it was only when users performed activities that entailed responsibilities in systems development that feelings of high involvement and positive attitudes were detected.

Participation is also related to user satisfaction with information. A study of 151 systems in eight organisations indicated that user participation has a direct positive influence on user satisfaction (McKeen et. al., 1994). Also in a study of 120 Egyptian managers working in 12 banks, users' participation showed a positive relationship with user information satisfaction (Khalil and Elkordy, 1997). A recent study on 52 EIS users found that user participation in EIS development is positively related to EIS information quality (Srivihok, 1999).

User participation is thought of as an essential principle of MIS development because it provides accurate assessment of the user needs and avoid the development of unnecessary features and thus increasing the system quality (Gyampah and White, 1993). Torkzadeh and Doll (1994) argue that participation lead to increased user acceptance by improving the user's understanding of the system; this could result in increased perceptions of ease of use. Hartwick and Barki (1994) argue that user active participation in the system development is likely to result in systems perceived as being important, personally relevant and good.

Previous researchers recommended the incorporation of user participation in future IT usage models (Barki and Hartwick, 1989; Taylor and Todd, 1995b; and Igbaria et. al, 1997). Moreover according to TAM, participation is expected to influence usage indirectly through its influence on beliefs. Therefore, the following hypotheses are proposed.

H7.1: Participation positively influences perceived ease of use

H7.2: Participation positively influences information quality

H7.3: Participation positively influences involvement

4.3.8.2 Information Systems Maturity:

Information systems maturity is defined as "the overall status of the MIS function within the organisation" (King and Sabherwal, 1992). It represents the progress of the IS function from the era of data processing and management information systems into the strategic IS era. The conceptualisation of IS maturity is based on models of the IS "stages of growth" (Nolan, 1973; Gibson and Nolan, 1974). In his first study, Nolan (1973) suggested that the IS expenditure, when plotted over time, exhibited an S-shaped learning curve. On this bases he hypothesised four stages of computer budget growth: initiation, contagion, control, and integration.

Gibson and Nolan (1974) expanded and revised the 1973 model to describe the management techniques necessary at each stage of growth, also the definitions of each stage were expanded to include application development, personnel specialisation, and management techniques and organisation. In this revised model the fourth stage was renamed the maturity stage where computer resources have reached full growth and are being applied to the key tasks of the organisation.

Schultz and Slevin (1975) and Ein-Dor and Segev (1978) were among the first to point to IS maturity as a determinant of information systems success (usage). In their model of implementation success, Schultz and Slevin (1975), presented the concept of "organisational validity" which implies that for an IT application to be implemented in an organisation, it must be compatible with that organisation. Given that the extent of IS function maturity determines the extent to which the organisation is ready for an advanced IT application such as EIS, the chances of such application to succeed are expected to increase with the maturity of the overall organisational IS function. Millet and Mawhinney (1992) argue that if the MIS structure is not well developed, management should consider postponing the investment in EIS until the MIS can adequately support the EIS.

Ein-Dor and Segev (1978) proposed a hypothesis relating organisational maturity to successful implementation of information systems. More recently, the absorptive capacity theory (Cohen and Levinthal, 1990) was applied to the context of IT usage. This theory implies that an organisation's absorptive capacity reflects its capability to "absorb," through its internal knowledge structures, information regarding IT innovations so that these innovations can be applied in support of operational or

strategic activities (Boynton et al, 1994). Thus it could be argued that higher IS maturity facilitates the absorption of sophisticated IT innovations such as EIS.

While the importance of the organisational context of information systems is acknowledged in previous literature, the empirical research on this class of variables has been much less extensive that that on individual differences (Raymond, 1990). One of the few studies that directly investigated the relation between systems maturity and success was Cheney and Dickson (1982). This study reported that the level of MIS department organisational sophistication defined as the planning, organising and controlling activities associated with managing the organisation's computer resources, positively influence user information satisfaction and systems usage. Mahmood and Becker (1985) also reported significant relationship between user satisfaction and some of Nolan benchmark maturity items namely, IS expenditure, IS technology, IS organisation and personnel resources, IS planning and control, and IS awareness.

In a study of 81 strategic information systems applications, King and Sabherwal (1992) reported that the maturity of the IS function is positively associated with the strategic use of information systems. This study defined IS maturity along dimensions such as top management knowledge of IS, IT manager's knowledge of the organisation's plans and operations, and the integration of IS with the firm's strategies. Grover and Teng, (1992) studied the relationship between the maturity of organisational IS and the adoption of database management systems in 288 medium and large corporations. The results indicated that adopters of DBMS tend to be operating in on-line environment with centralised IS processing and control, the end users are usually responsible for the data entry, while the IS group retains the responsibility for data quality. Adopters also tend to be larger organisations with longer experience with IS.

Another study reported a positive relation between IS sophistication (the organisation's managerial and technical sophistication in implementing, operating and using its information systems), and IS success (usage and satisfaction) (Raymond, 1990). Results from a survey of senior IT managers found that managerial IT knowledge (the conjunction of IT-related and business-related knowledge possessed by and exchanged among IT managers and business managers) is a dominant factor in explaining the extent of IT use (Boynton, Zmud, and Jackobs, 1994). In a study of

240 managers, Selim (1997) found IS maturity to be the main determinant of user satisfaction with information systems and perceived usefulness.

The review of literature presented above shows that few empirical investigations have been directed towards understanding the impact of IS maturity on the individual utilisation of IT, moreover this important variable was not considered before in the context of EIS. Millet and Mawhinney (1992) recommended that future studies should clarify the relationship between EIS success/failure and the development stage of MIS in the organisation. Igbaria et.al (1997) and Taylor and Todd (1995) recommended that future studies should consider the influence of the organisational context factors, such as MIS maturity, on the individual use of IT.

According to the TAM and the TRA, maturity of the IS function (external factor) will influence IT acceptance indirectly through beliefs. The rational behind this proposition is that as the IS function matures, the IS staff gain experience with designing and developing information systems application which could directly enhance the quality of various information systems applications, especially strategic systems such as EIS. IS maturity is also expected to enhance the overall awareness and appreciation of EIS. Finally, the maturity of the IS function reflects longer experience with IT in the organisation which could positively impact EIS perceived ease of use. Thus, the following hypotheses are proposed.

H8.1: Information system maturity positively influences perceived ease of use

H8.2: Information system maturity positively influences information quality

H8.3: Information system maturity positively influences user involvement

4.3.8.3 Computer Training:

Computer training is defined as the amount of computer related training from various sources. In spite of the large investment in training by organisations, only 10% of this training is reported to lead to a change in behaviour on trainee's job (Venkatesh, 1999). Training is considered one of the secrets to systems success that can save companies millions in invested dollars, reduce negative impacts to customer service and enhance employee morale and systems acceptance particularly in the end user computing environment (Coe, 1996; Nord and Nord, 1994). Previous studies that extended TAM acknowledged the role of training as an important external factor

affecting user perceptions about technology (e.g., Igbaria et al, 1997; Venkatesh, 1999).

Computer training was found to have a positive relationship with usage (e.g., Amoroso and Cheney, 1991; Nelson and Cheney, 1987; Igbaria et al, 1995, Torkzadeh and Dwyer, 1994), and satisfaction with the system (e.g., Cronan and Douglas, 1990; Sanders and Courtney, 1985). Training was also reported to promote greater understanding, favourable attitudes, and more systems use (Raymond, 1988). The investigation of the impact of training on intervening factors such as user involvement, user satisfaction and perceived ease of use may help in understanding the conflicting research findings relating training to systems usage.

In their study of ease of use determinants, Venkatesh and Davis (1996) found that hands-on training has increased the level of perceived ease of use. Igbaria et al (1997) reported that external training had a positive influence on perceived ease of use, while internal training had no significant influence. Torkzadeh and Dwyer (1994) found that training positively influences user involvement and user satisfaction. Additionally, results of Torkezadeh et al (1999) suggested that training significantly improved computer self-efficacy.

Understanding the impact of training on user perceptions is theoretically and practically important. From a theoretical point of view little is known about the impact of user training on various user perceptions found to promote use. From a practical perspective, feedback about the effect of various training policies should guide the effective allocation of training resources (Agarwal et. al., 1996). According to TAM, computer training is expected to influence usage indirectly through its influence on beliefs. Therefore, the following hypotheses are proposed.

H9.1: Computer training positively influences perceived ease of use

H9.2: Computer training positively influences information quality

H9.3: Computer training positively influences user involvement

4.3.8.4 User Experience:

Szajna (1996) recommended introducing an experience factor when studying TAM. Also according to the Triandis' 1980 model, prior experience with the behaviour of interest is the strongest source of forming beliefs concerning it. Thompson et al

(1994) suggested that within the context of IT use, both skill level and length of use should be considered in defining user experience. For example, an individual can use a computer to do simple data retrieval for several years, but would still have low computer use skills.

User experience had a positive relationship with system acceptance (Vasarhelyi, 1977), and with the user's willingness to use the system (Yaverbawm, 1988). It was also found to positively influence perceived information quality (Gatian, 1994; Sanders and Courtney, 1985). Thompson et. al. (1994) found that user experience is a major determinant of perceived use complexity (opposite of ease of use). Also Al-Gahtani and King (1999) found that end user experience have a direct and positive influence on ease of use and attitudes towards usage. Based on prior studies and consistent with TAM, the following hypotheses are proposed.

H10a.1: Use experience positively influences perceived ease of use

H10a.2: Use experience positively influences information quality

H10a.3: Use experience positively influences user involvement

H10b.1: Computer use skill positively influences perceived ease of use

H10b.2: Computer use skill positively influences information quality

H10b.3: Computer use skill positively influences user involvement

4.4 Conclusion:

This chapter presented the integrated EIS use model proposed by this study. The chapter starts by discussing the rationale behind integrating the technology acceptance model with other constructs from the IS/EIS use literature. The second part of this chapter presents the research model and the hypotheses associated with it supported by a survey of the relevant literature. The integrated model of EIS use proposes that, in addition to TAM's perceived usefulness and perceived ease of use, information quality, user involvement, subjective norm, and facilitating conditions have a positive impact on EIS usage.

The model also proposes that, in addition to TAM's perceived ease of use, information quality, user involvement, facilitating conditions and subjective norm positively influence perceived usefulness. The research model also extends TAM by exploring the influence of important external factors on user beliefs. It is hypothesised

that user participation, IS organisational maturity, computer training, and user experience positively influence beliefs of information quality, user involvement, and perceived ease of use. The next chapter is concerned with the research methodology used by this study to test the empirical validity of the proposed model.

Chapter 5

The Research Methodology

5.1 Introduction:

The last two chapters were directed to fulfilling the first objective of this study; i.e., to develop a model of the determinants of EIS use based on existing IS usage models as a foundation. Chapter three presented an evaluative survey of prior theoretical and empirical literature related to the determinants of IS usage. Based on this review a model of EIS use was developed and is introduced in chapter four. The second objective of this study is to test the empirical validity of the research model. This chapter is concerned with the research methodology used in this study.

To facilitate the testing of the research model, the research hypotheses presented in the previous chapter are re-classified into five groups corresponding to the five dependent variables included in the model, that is, EIS usage, perceived usefulness, perceived ease of use, perceived information quality, and user involvement. The research strategy used in this study is then introduced together with the rationale behind such a choice. The pilot study, the process of selecting the respondents, the response rate, of the response-bias analysis, and the respondent's characteristics are then described. Definitions and measures of the research variables are presented and finally, the statistical analysis techniques used to analyse the collected data are introduced.

5.2 Research Hypotheses:

To facilitate the validation of the proposed model, the hypotheses embedded in it are arranged into five groups concerned with the determinants of EIS use, perceived usefulness, perceived ease of use, information quality, and user involvement. According to the model, usage is determined by six independent variables, namely perceived usefulness, perceived ease of use, perceived information quality, user involvement, subjective norm and facilitating conditions. Perceived usefulness is in turn dependent on ease of use, information quality, involvement, subjective norm and facilitating conditions. Ease of use, information quality, and involvement are dependent on four external factors, namely participation, information systems

maturity, computer training, and user experience (duration of EIS use and computer use skills).

5.2.1 Research Hypotheses Related to EIS Use:

H1-1 Perceived usefulness positively influences use.

H1-2 Perceived ease of use positively influences use.

H1-3 Perceived information quality positively influences use.

H1-4 User involvement positively influences use.

H1-5 Subjective norm positively influences use.

H1-6 Facilitating conditions positively influences use.

5.2.2 Research Hypotheses Related to Perceived Usefulness:

H2-1 Perceived ease of use positively influences perceived usefulness.

H2-2 Perceived information quality positively influences perceived usefulness

H2-3 User involvement positively influences perceived usefulness

H2-4 Subjective norm positively influences perceived usefulness

H2-5 Facilitating conditions positively influences perceived usefulness

5.2.3 Research Hypotheses Related to Perceived Ease of Use:

H3-1 Participation positively influences perceived ease of use

H3-2 Information system maturity positively influences perceived ease of use

H3-3 Computer training positively influences perceived ease of use

H3-4a Duration of EIS use positively influences perceived ease of use

H3-4b Computer use skill positively influences perceived ease of use

5.2.4 Research Hypotheses Related to Perceived Information quality:

H4-1 Participation positively influences perceived information quality

H4-2 Information system maturity positively influences perceived information quality

H4-3 Computer training positively influences perceived information quality

H4-4a Experience of EIS use positively influences perceived information quality

H4-4b Computer use skill positively influences perceived information quality

5.2.5 Research Hypotheses Related to User Involvement

H5-1 Participation positively influence user involvement

H5-2 Information system maturity positively influences user involvement

H5-3 Computer training positively influences user involvement

H5-4a Duration of EIS use positively influences user involvement

H5-4b Computer use skill positively influences user involvement

5.3 Research Methodology:

The following section presents the research methodology used to test the empirical validity of the hypotheses embedded in the research model. This section starts with a review of research strategies used in the study of information system and the research method deployed in this study. Then it describes the pilot study, sampling procedure, survey response, response-bias analyses, and characteristics of respondents. The variables definitions and measures and the statistical analyses techniques used to analyse the data are also described.

5.3.1 Research Strategy:

5.3.1.1 Research Approaches in the Study of Information Systems:

Information systems approaches are classified into two categories, namely, scientific/empirical and interpretivist. Scientific approaches assume that observations of the phenomenon under study can be made objectively and rigorously. They are characterised by repeatability, reductionism, and refutability. Interpretivist approaches argue that the dispositions of scientific research are misplaced in social science because of the possibility of many different interpretations of social phenomena, the impact of the social scientist on the social system under study, and the difficulties in predicting future events concerned with human activity (Galliers, 1992).

Table 5-1 Information systems research approaches (Galliers, 1992 p. 149)

Scientific/positivist	Interpretivist
Laboratory and experiments	Subjective/argumentative
Field experiments	Reviews
Surveys	Action research
Case studies	Descriptive/interpretive
Theorem proof	
Forecasting	Futures research
Simulation	Role/game playing

Galliers (1992) presented a summary of the literature concerning the research methods advocated as being suitable for research in the field of information systems and suggests a taxonomy of IS research methods (Table 5-1). The most important point is that no one approach has universal applicability in the study of information systems.

However, the taxonomy of information systems research methods helps researchers to identify the situations in which individual approaches appear to be best suited in relation to the general topic area and the process of theory development in the specific topic area being researched.

This study adopts an empirical/positivist philosophy to the study of EIS use determinants. The main reason is the nature of the study objectives in establishing associations between variables and finding out the cause and effect relationships between them with a greater degree of certainty. Such philosophy implies the assumption that the phenomenon under study could be operationalised and measured using rigorous instruments. Table 5-2 depicts a summary of the key features, strengths, and weaknesses of alternative empirical research approaches mostly used in prior information systems studies. Laboratory and field experimental design are both concerned with controlling and manipulating the independent variable so that its causal relationship with the dependent variable could be established. Non-experimental design (case study research and survey research) is more appropriate to research in social science when the researcher is not in the position to intrude and manipulate variables.

Table 5-2: Empirical/positivist research approaches (Adapted from Galliers, 1992)

Approach	Key features and strengths	Weaknesses	Appropriateness for the study objective
Laboratory experiments	The control of a small number of variables which may then be studied intensively in a laboratory setting	The limited extent to which identified relationships exist in the real world due to over simplification of the experimental situation and its isolation from most of the variables found in the real world	Appropriate for testing causal relations, but less suitable because of low generalisation and the difficulty in controlling the large number of variables included in the proposed model
Field experiments	Extend laboratory experiments into real life situations of organisations which results in more realism	Finding organisations prepared to be experimented on	Appropriate for testing causal relations, but more difficult in studying EIS use because of the nature of the informants (managers).

Table 5-2 (Continued)

Approach	Key features and strengths	Weaknesses	Appropriateness for the study objective
Case studies	Attempt to describe relationships, which exist in reality, within a single or a limited number of organisations. This makes it possible to capture reality in greater details and to analyse more variables.	Restriction to single/ few organisations limits generalisation of results. Problems of acquiring similar data from a statistically meaningful number of cases. Lack of control of variables. Different interpretations of events by individual researchers.	Less appropriate for testing causal relations. Difficult to generalise results concerning the validity of the research model to other cases.
Surveys	Provide snapshots of practices at a particular point of time regarding relationships that exist in the past, present and future. Allow a greater number of variables to be studied than in experimental approaches. Descriptive of real world situations. More easy/appropriate generalisations	Likely that little insight obtained regarding the causes/processes behind the phenomena being studied. Possible bias in respondents, the researcher, and the moment in time at which the research is undertaken	More feasible and appropriate in allowing the use of statistical analysis such as regression for testing causality. Provides a systematic method for validating the proposed model and obtaining results that may be generalised. Suitable to the study of utilisation across a wide range of organisations and environments.

While case study research provides an in-depth, detailed analysis of a small number of subjects basically for descriptive purposes, it is less suited to providing generalisable results for theory testing. On the other hand, survey research is often used to gather information from a large number of respondents representing of the research population. The results are then used to describe or make inferences about some phenomenon concerning the larger population. Among the scientific approaches, surveys are seen as the most suitable for the purpose of validating the proposed EIS use model, which requires gathering an extensive amount of data across various organisations where the researcher has minimal control over the phenomenon under study.

5.3.1.2 The Research Method Deployed in this Study:

A cross-section mail survey appeared to be the most appropriate strategy for testing the empirical validity of the causal model proposed by the present study. Survey research is the best known and most widely used method of obtaining data in social sciences (Singleton, Straits and Straits, 1993). Surveys are also the most widely used method in the management information systems field; they have been employed in about 36 percent of MIS journal articles and 34 percent of dissertations in the management information field (Kraemer and Dutton, 1991).

The major design option in the survey research is whether to use a cross-sectional or longitudinal design, that is whether to collect the data once or to repeat the questions over time in order to establish a cause-effect relationship (Singleton et al, 1993). Lucas (1990) argues that information systems researchers seeking to establish causality among variable should strive to collect data over time using longitudinal design. Unfortunately, this was not possible in the present study due to time and resources constraints. However, cross-section surveys, when designed properly, can provide strong evidence of causality.

The validation of the research model is conducted across organisations that use several different executive information systems. For any given implementation there may be specific factors (advantages or disadvantages) that are not included in the model and which may influence the usage of EIS. Ideally the effect of those factors needs to be identified and separated from the effects of the variables in the model. However a generalisation could be made if a sample is drawn from a wide range of organisations with a sample size large enough to enable the researcher to assume that confounding effects cancel each other. The development of valid models capable of explaining systems usage across organisations and systems is also important to practitioners who need to develop systems applicable to different situations.

Usually the mode of gathering information in survey studies is structured questionnaires, which can either be administered through a mail survey, or conducted via a telephone or face- to- face interview. Due to financial, time, and manpower limitations, the survey in this study could not be administered through personal interviews, especially because the respondents were scattered across the UK. Also

telephone interviews were not feasible due to the high cost of conducting telephone calls and the difficulty in finding the right time to make the calls as well as the low responsiveness of senior executives to telephone interviews.

Mail surveys are best suited to situations when a substantial amount of information needs to be obtained through structured questions, at minimal costs, and from a sample that is widely dispersed geographically. Moreover data collected through mail surveys may be more valid than those collected via phone or face to face interviews as they allow the respondents the time to check information and alleviate the danger of interviewer bias. As mail surveys tend to have lower response rates, follow-up efforts are especially important to this mode. Therefore a mail survey was chosen as the most appropriate data collection method for this study.

5.3.2 Pilot Study:

The research instrument was pilot tested on all 200 participants in executive MBA evening program at City University Business School. Most of the students were full time executive/part time students, thus they were considered representative of the real world managers. The university internal mail was used to distribute the questionnaires, which was accompanied by an introductory letter from the researcher. Only 22 responses were returned, giving 11% response rate. Such a low rate reflected the need to administer a larger number of questionnaires in order to get the minimum number of responses required to perform the statistical data analysis; 100 at least to perform a regression analyses.

The main comments from the pilot study were on the length of the questionnaire and the repetitiveness of some of the items, especially the user involvement and participation questions. Thus in the final questionnaire the number of items measuring those two variables was shortened. The small number of questionnaires returned from the pilot study did not allow for statistical analyses to validate the research instruments, however the items in the questionnaire were mainly derived from previously verified sources.

5.3.3 Sampling Procedure:

The study population consists of all potential users who have an EIS available to them in the support of their work. The lack of information concerning the EIS user

population precludes random selection and thus makes the use of a purposive sampling design acceptable. In this form of sampling the researcher "relies on his or her expert judgement to select units that are representative or typical of the population" (Singleton et al, 1993). Most of the past studies on EIS have used selective sampling primary because only some firms are believed to have an EIS in place (Bajawa, Rai, and Brennan, 1998). Table 5-3 shows a summary of the sample design and the response rate of some EIS survey studies. The review of this data shows that most of the time the use of purposive sampling leads to a higher response rate.

Table 5-3: Sample design used in prior EIS survey studies

Study	Description of Sample	Response Rate
Bajawa, Rai, and Ramaprasad, 1998	A random sample of 1423 firms listed in the USA directory of top computer executives.	238 responses were received giving a response rate of 16.7%
Bergeron, Raymond, and Laforge, 1991	900 organisations listed in the directory of the Canadian information processing society were asked to complete the questionnaire if they have an EIS	17.1% organisations responded. Only 3.1% had EIS in place (52 individual users)
Fitzgerald, 1992	500 individuals in the UK who expressed interest in EIS to Business Intelligence Ltd. (attendees of EIS conferences or purchase of EIS reports)	15.7% were returned, only 7.2% (36 respondents) were using EIS.
Watson, Rainer, and Frolic, 1992	A sample of 300 organisations drawn from University of Georgia database of organisations that have or are likely to have EIS	21% response rate (68 returned, 51 completed)
Walstrom and Wilson, 1997	The population was the 1000 Corporate Elite CEOs identified by Business Week as they were believed to posses above-average percentage of EIS use	9.8% responded (98 responses), out of which 4.3% (43 responses) were EIS users.
Benard and Satir, 1993	Top executives of 493 Canadian organisations that are Financial Post 500 companies	74 replies were received, giving a response rate of 15%.

Customer lists of major EIS vendors are one of the most direct sources of information regarding EIS users (Elam and Leidner, 1995). All EIS vendors attending the Business Intelligence Conference' 97 were contacted during the event and were asked for their customer lists. Only one major vendor, Comshare, agreed to give out their

customer list to the researcher. While its EIS software "Commander EIS" is considered the leading EIS product in the world with 26% of the market share (Partanen and Savolainen, 1995). There is no evidence that the Comshar's customer list is representative of the EIS user population in the UK. Thus the generalisation of the results of this study is restricted by the characteristics of the sample driven from that list.

The researcher asked to use Comshare's customer database, which contains detailed information including names and address of customers to facilitate the mailing of the questionnaire. Access to the addresses was agreed on condition that letters containing the names and addresses of the customers are printed at the vendor premises in order to protect the privacy of the customers. No respondents were asked to give their name or that of their company and they were promised complete anonymity, thus there was no way to identify the respondents.

All managers on the list were sent a package containing a copy of the questionnaire, a cover letter from Comshare to present the researcher to its customers, and a stamped enveloped addressed to the researcher. To allow time for transit in both directions, fourteen days after the initial mailing, they were sent a reminder letter. Approximately three weeks after the reminder letter, a second mailing was sent. As the questionnaire was completely anonymous, re-mailing to the respondents only was not possible. Thus the second mail contained the questionnaire, unstamped envelope addressed to the researcher, and a letter from the researcher including a thank you to those who responded and a more thorough explanation of why each respondent's co-operation was important to the study. A copy of the cover letter and the questionnaire are provided in appendix 5-1.

5.3.4 The Survey Response:

Out of the 960 questionnaires mailed to all managers on Comshare's customer list, 216 completed questionnaires were returned after the initial mailing, reminder letter, and the second mailing. Yet 25 questionnaires came back because the person on the list had changed jobs or companies and could not be located. According to Babbie (1990) the acceptable practice for calculating the response rate is to subtract the number of questionnaires that could not be delivered due to bad address. Then the

number of completed questionnaires is divided by the net sample size. This gives a response rate of 23.10 % (216/935*100), which compares favourably with survey results in previous studies (See table 5-3).

To establish the reasons for not responding to the survey, the cover letter accompanying the second mailing asked the respondents, *if they absolutely had no intention to complete the survey*, to identify their reason. Four main reasons for not completing the questionnaire were provided by the respondents (table 5-4): (1) Did not believe that their company had an "EIS" (47 cases). (2) Company policy against answering questionnaires (25 cases). (3) The company stopped using EIS (10 cases). (4) Not the relevant person to answer the questions (9 cases).

Table 5-4: Reasons for Returned Incomplete Questionnaires

Reasons for not completing the questionnaire	number	percentage
1. Do not have an EIS	47	51.65%
2. Against company policy	25	27.47%
3. Stopped using EIS	10	10.98%
4. Not the relevant person	9	9.98%
Total	91	100%

5.3.5 Non-Response Bias Analysis:

Given that the respondents were promised total anonymity and that the researcher had no direct access to the names and addresses stored at the vendor's database, it was not possible to get demographic information regarding the non-respondents to compare them with the respondents. Thus barring more direct tests of bias, the researcher may assume that respondents who failed to answer the questionnaire will be more like those who delayed answering rather than those who answered right away (Babbie, 1990, p 180). Thus an analyses of the questionnaires received at different point of the data collection might be used to estimate the non-response bias.

Six demographic factors were compared between the first 35 respondents and the last 35 respondents. Those were age, years of education, managerial level, managerial experience, number of employee, turnover, and number of EIS functions. The intermediate responses were discarded to ensure a significant separation between the early and late responses. The statistical test used was analysis of variance (ANOVA). For each factor, the mean value for the first 35 respondents from the first mail was

compared with that for the last 35 respondents from the second mail. Table 5-5: Response Bias Analysis: Demographic Data

Sample Characteristics	Mean (first 35 /first mail)	Mean (last 35 /second mail)	ANOVA	
			F	P
Age of respondents	41.4000	39.0588	1.484	0.227
Years of education	15.9143	16.3793	0.035	0.853
Managerial experience (years)	11.5429	9.9714	0.326	0.570
Number of employees	9362.5806	6206.0938	1.586	0.213
Turnover in £ million	1141.3571	928.9615	1.258	0.267
Number of EIS functions	4.7143	4.8286	1.332	0.252

The results (table 5-5) indicate that there are no statistically significant differences between the respondents from the first wave and those from the second. This test suggests that respondents to the survey are representative of the population and that their responses could be aggregated across the two response waves (Babbie, 1990; King and Sabhrawel, 1992).

5.3.6 Characteristics of Respondents:

Following is a descriptive analysis of the demographic characteristics of the respondents. The results of this analysis draw the profile of the EIS users who provided the data used to test the research model. Those results provide the limits of generalisation of the results of this study. Thus any generalisation of the hypotheses testing results presented in the following chapters should be limited to users and systems with characteristics similar to those covered by this study, while any further generalisations should be treated with caution.

Table5-6: Distribution of Respondents on Industry Sectors

Industry Sector	Frequency	Percentage
Finance/Banking/ Insurance	44	20.4
Pharmaceuticals, Chemicals	22	10.2
Health Service	21	9.7
Retail, Trade	35	16.2
Government	4	1.9
Public Utilities	9	4.2
Manufacturing, Engineering	48	22.2
Publishing, Media, Information	5	2.3
Airline, Transportation, leisure	8	3.7
Logistics, Distribution	15	6.9
Others	5	2.3
Total	216	100

The analyses show that the respondents represented a broad cross-section of different industries and different sized firms, which enhances the generalising of the research results. Table 5-6 depicts the distribution of respondents across industry sectors. It shows that 22.2% came from the manufacturing and engineering sector, 20% from finance, banking, and insurance, 16.2% from retail and trade, 10.2% from pharmaceuticals and chemicals, 9.7% from health service, and 6.9% from logistics and distribution. Also 4.2% of the respondents came from the public utilities sector, 2.3% from publishing, media, and information, 1.9% from government, and 2.3% from other industries.

Table 5-7 describes the distribution of respondents according to the number of employee of their companies. It shows that the respondents came from companies with varying sizes ranging from less than 500 to more than 25,000 employees. It also describes the distribution of respondents according to the annual turnover of their companies. This table shows that a wide range of company sizes were represented in the study sample ranging from less than 100 million annual turnover to more than five billion.

Table 5-7: Distribution of respondents according to company size

Dimensions of company size	Frequency	Percentage
Number of employee		
≤ 500	21	9.7
501-1000	19	8.8
1001-5000	91	42.1
5001-10000	31	14.4
10001-25000	23	10.6
More than 25000	19	8.8
Missing	12	5.6
Total	216	100
Annual Turnover		
<100 Million	21	9.7
100-499 Million	81	37.5
500-999 Million	32	14.8
1-2 Billion	17	7.9
>2-5 Billion	17	7.9
>5 Billion	12	5.6
Missing	36	16.7
Total	216	100

Table 5-8 shows the descriptive statistics concerning the respondents' age, gender, managerial level and functional area.

Table 5-8: Demographic characteristics of respondents

Personal characteristics	Frequency	Percentage
1- Age: Mean (39.2617), Range (23-60)		
Less than or equal to 30	29	13.4
31-40	95	44.0
41-50	69	31.9
51-60	21	9.7
Missing	2	0.9
Total	216	100
2- Gender:		
Male	191	88.4
Female	25	11.6
Total	216	100
3- Education level:		
High school (11-12 years of education)	9	4.2
College (13-14 years)	26	12.0
University (15-18 years)	127	58.8
Post Graduate Studies (more than 18 years)	37	17.1
Missing	17	7.9
Total	216	100.0
4- Years in current position		
One year and less	50	23.1
>1-2 years	47	21.8
>2-3 years	39	18.1
>3-5 years	46	21.3
More than 5 years	33	15.3
Missing	1	0.5
Total	216	100.0
3- Managerial Level:		
Senior level Managers:		
One level below CEO	30	13.9
Two levels below CEO	103	47.7
Middle level Managers:		
Three levels below CEO	29	13.4
Four levels or more below CEO	38	22.2
Missing	6	2.8
Total	216	100.0
4- Functional Area:		
General	33	15.3
Production	3	1.4
Finance/Accounting	116	53.7
Marketing/Sales/Advertising	22	10.2
IT/IS	41	19.0
Missing	1	0.5
Total	216	100

The information concerning the age of respondents shows an average age of 39 years. Additionally, the distributions of age show that 75.9% (44%+31.9%) fall between 41 to 60 years. This implies that most of the respondents were educated in a pre-computer era. An earlier survey of EIS users (Courtney, 1992) had reached the same conclusion. The descriptive data show that the majority (88.4%) of the respondents is males. This may reflect the low representation of females in higher managerial roles. Information regarding the level of education reflects that the majority of the respondents (58.8+17.1+7.9=83.8%) received university education or higher. Information about the number of years in their current position reflects a balanced distribution ranging from less than one to more than five years.

Although senior executives defined as the chief executive and two levels below were intended to be the main target of the study, table 6 shows that none of the respondents reported as being at CEO level. The respondents consisted of 13.9% one managerial level below CEO, 47.7% two levels below CEO, 13.4% three levels below CEO, and 22.8% four levels or more below CEO. Prior research shows that EIS systems are frequently used at middle management levels (Watson, Rainer, and Koh, 1991) and lower levels (Nord and Nord, 1996). Empirical evidence show that there is no difference in the outcome of EIS use for senior and middle managers suggesting that EIS is relevant at both levels (Leidner and Elam, 1995). Thus EIS users in this study will include both top and middle executive managers.

Finally the data show that the respondents came from varying functional areas. 53.7% of the respondents reported to be working in the area of finance and accounting. Managers from IT/IS functional area constituted 19% of the respondents, 15.3% reported as working in general management positions, 10.2% from marketing, sales, and advertising, and only 1.4% reported to work in production.

5.3.7 Variables Definitions and Measures:

This section presents the research variables definitions and a description of the scales used to measure them. The instruments used in this study have been formally validated in previous methodological studies or have been used previously in more than one empirical study. Almost all the scales depend on multiple items; i.e. contain a number of statements pertaining to each of the variables, each with a rating scale

attached to it. Multiple-item scales are capable of producing more reliable measures than single-item scales because summing the ratings across a number of items has the effect of neutralising random fluctuations. They also result in more valid measures because they allow the researcher to capture all aspects of the construct to be measured (Parasuraman, 1991 p. 441). The questionnaire consisted of 17 questions pertaining to the model variables and 11 demographic questions to provide demographic information about the respondents and their companies (Appendix 5-1).

5.3.7.1 EIS Usage

Usage is defined as "the behaviour of employing the system in completing tasks" (Goodhue and Thompson, 1995 p. 218). Numerous studies measured usage in terms of absolute quantity or frequency. Examples are number of messages sent by e-mail, number of hours using the package, frequency of use (not at all/several times each day), number of visits to the computer centre, number of finished assignments.

Table 5-9: Items used to measure dimensions of EIS use

1- Use of EIS-based information:
Percentage of information needs satisfied through direct use of the EIS
Percentage of information needs satisfied through EIS output provided by others
2- Duration of use:
Amount of time usually spent using EIS in average week
3- Frequency of using EIS to perform the following acts:
Read regular / standard EIS reports
Request others to prepare customised reports
Retrieve data on key performance indicators
Detect trends in critical performance parameters
Perform ad hoc querying of databases
Access company news
Monitor information about competitors
Monitor national and/or international information

Others argue that proportional measures are more suitable than absolute measures. For example, Goodhue (1992, p.307) suggests that "an appropriate measure of usage...might be to ask, out of all those tasks for which the system is appropriate, for

what percentage does a manager actually use the system". Straub et al. (1995, p. 1339) suggest that "system usage may best be conceived as the proportion of activity on a particular system or medium relative to all activities on alternative media".

Another important issue relevant to the measurement of usage is the objective versus reported (perceived) measure. A recent survey of systems use measures reported that most of the prior studies depended on subjective self reported measures of systems usage (Straub et al., 1995), especially when objective use measures are not available. More over, computer-monitoring software does not reflect the context in which usage takes place (Grand and Higgins, 1996; Melone, 1990), thus it might not be appropriate for reflecting user behaviour across different tasks and systems. Previous research reported that self-reports are appropriate as a relative measure especially in the case of more frequent behaviours such as media usage (Blair and Burton, 1987).

Consistent with previous IT acceptance research (e.g. Igbaria et. al., 1995, 1997; Bergeron et. al., 1995) and in order to enhance the reliability of the use measure, this study measures use by three criteria (table 5-9). Firstly, the extent of the user dependence on EIS-based information compared to other information sources, namely personal contacts and paper-based sources, as an approximate percentage of the user total information needs (Elkordy, 1994). The respondents are asked to report on the percentage of their information needs satisfied through personal contacts, paper-based sources, direct use of EIS, and EIS output provided by others.

Secondly, the researcher followed the recommendations of Fishbein and Ajzen (1975) to use several acts to measure category behaviour. Thus the study asks the respondents to determine, on a 5-point scale (never, less than once a month, monthly, weekly, and daily), the frequency of performing a set of EIS use acts. For example, reading standard reports, performing ad-hoc querying of databases, detecting trends, and accessing company news. Thirdly, based on Mawhinney and Lederer (1990), usage was measured by asking respondents to report the average duration of EIS use in terms of number of hours per week. The three measures used in this study are self-reported measures of actual use rather than measures of the degree of use on an ordinal scale such as high/low or frequent/infrequent use.

5.3.7.2 Perceived Usefulness

Perceived usefulness is defined as the degree to which the person believes that using a certain technology will enhance his or her performance (Davis, 1989). The study uses the perceived ease of use instrument developed and tested by Davis (1989). The validity and reliability of this instrument have been evaluated by numerous studies (e.g., Adams et. al., 1992; Chin and Todd, 1995; Hendrickson et al, 1993; Davis and Venkatesh, 1996). Respondents were asked to indicate on a five-point scale (strongly disagree, disagree, uncertain, agree, and strongly agree) their perceptions concerning EIS usefulness (table 5-10).

Table 5-10: Items used to measure EIS perceived usefulness

1. My use of EIS increases my productivity on the job
2. My use of EIS makes it easier to do my job
3. My use of EIS enhances my effectiveness on the job
4. My use of EIS improves my job performance

5.3.7.3 Perceived Ease of Use

Based on Davis (1989), perceived ease of use is defined as the degree to which a person believes that using a certain system is effort free. The study uses the perceived ease of use instrument developed and tested by Davis (1989) and verified by other researchers (e.g., Adams et al, 1992, Chin and Todd, 1995). Respondents were asked to indicate on a five point scale their agreement or disagreement with four statements pertinent to EIS perceived ease of use (table 5-11).

Table 5-11: Items used to measure EIS perceived ease of use

1. I find EIS easy to interact with
2. I find it easy to get EIS to do what I want it to do
3. My use of EIS requires a lot of mental effort
4. I find it is easy to become skilful at using EIS

5.3.7.4 Perceived Information Quality

Leidner (1996) and Seddon and Kiew, (1994) define information quality in terms of the satisfaction with the characteristics of information generated by an information system, such as timeliness, accuracy, accessibility, relevance, and completeness. The

present study is concerned with the user beliefs about the EIS information quality rather than the technical quality. The IS literature provides different measures of user satisfaction (Kim, 1989; Delone and McLean, 1989). This study measured perceived information quality using the end user computing satisfaction (EUCS) instrument developed and tested by Doll and Torkzadeh (1988). Such measure was deemed more appropriate than the "user information satisfaction" instrument (Baily and Pearson, 1983; Ives et al, 1983) which is considered more suitable in the context of transaction processing information systems (Baroudi and Orlikwiski, 1988).

Table 5-12: Items used to measure EIS information quality

1. Do you think the output is presented in a useful format?
2. Is the information clear?
3. Is the information accurate?
4. Does EIS provide the critical information you need?
5. Does EIS provide sufficient information?
6. Does EIS provide up-to- date information?
7. Do you get the information you need in time?
8. Does EIS provide reports that are about exactly what you want?
9. Does the system provide the precise information you need?

The end-user computing satisfaction instrument consists of five sub-scales; content, accuracy, format, ease of use and timeliness. A confirmatory factor analysis of the instrument revealed that it can be used as a standardised measure of user satisfaction with a specific application and that researchers can use these sub-scales with confidence as they have adequate validity and reliability (Doll, Xia, and Torzadeh, 1994). The overlap between the three items that ask the respondents to evaluate ease of use of the system and the construct of perceived ease of use could cause artificial inflation of the correlation between information quality and perceived ease of use. The researcher followed the recommendations of Seddon and Kiew (1994) to eliminate these items from the measure of satisfaction with information quality. Thus the respondents were asked to answer 9 questions concerning the information quality of their EIS on a 5-point scale ranging from hardly ever, 25% of the time, 50% of the time, 75% of the time, to always (Table 5-12).

5.3.7.5 User Involvement

User involvement is defined as the degree to which the user believes that the system possesses two characteristics: relevance and importance (Barki & Hartwick, 1989). This construct is measured using the instrument developed and tested by Barki and Hartwick (1994). The respondent is asked to describe the importance and relevance of EIS to his/her job on a 7-point scale. The study used six pairs of adjectives: important/unimportant, essential/nonessential, trivial/fundamental, of no concern to me/of concern to me, relevant to me/irrelevant to me, matters to me/doesn't matter to me.

5.3.7.6 Subjective Norm:

This study defines subjective norm as "the person's perception that most people who are important to him think he should or should not perform the behaviour in question" (Fishbein and Ajzen, 1975, p.302). The important others included superiors, colleagues, subordinates, and IS staff. Subjective norm can be assessed in a relatively direct manner by asking respondents to judge how likely it is that most people who are important to them would approve to their performance of the behaviour. When such direct measure was compared to estimates of subjective norms computed by multiplying beliefs concerning each referent group by the motivation to comply, correlation between the two were generally quite high (Ajzen, 1988 p 121).

Thus this study adapted the instruments developed by Bergeron et al. (1995) and Thompson et al (1991) for measuring the influence of subjective norm on the use of EIS. Respondents were asked on a 5-point scale (no extent, low extent, average extent, great extent, and very great extent) to describe the extent to which superiors, colleagues, subordinates, and IS staff expect them to use EIS.

5.3.7.7 Facilitating Conditions

Triandis (1980) defines facilitating conditions as objective factors in the environment that can make an act easy or difficult to do. In accordance with Bergeron et al (1995), this study deploys EIS sophistication as a surrogate criterion for facilitating conditions. Bergeron et.al (1995) measured EIS sophistication by ascertaining the presence of various technical features associated with EIS applications. The study

adapted this measure by asking the respondent to choose (place a tick) the EIS capabilities available in their EIS out of a list of eight capabilities. Those were: read only standard reporting, exception reporting, ad-hoc/unscheduled query, drill down capability, simple analyses such as spreadsheets, what if analyses/modelling, external databases, and soft data such as news and forecasts.

5.3.7.8 User Participation:

In prior information systems research, user participation was generally labelled user involvement (Barki and Hartwick, 1989), however it has been measured as a set of activities performed during the development of the system (e.g., Swanson, 1974; Ives and Olson, 1984; Baroudi et. al 1986; Franz and Robey, 1986). This study defines participation following Barki and Hartwick (1989) as the activities performed by users during the design, implementation and operation of the information system. Based on the results of Hartwick and Barki (1994), only the responsibility dimension of the instrument developed and tested by Barki and Hartwick (1994) was seen as relevant to the present research. Thus, respondents were asked to indicate on a no/yes scale whether they performed 8 activities (see table 5-13) during the development of the EIS currently available to them.

Table 5-13: Items used to measure user participation in EIS development

1. Were you the leader of the EIS project team?
2. Did you have responsibility for estimating development costs of EIS?
3. Did you have responsibility for requesting additional funds to cover unforeseen time/costs overruns?
4. Did you have responsibility for selecting the software and/or the hardware needed for EIS?
5. Did you have responsibility for the success of EIS?
6. I had main responsibility for the development project during system definition
7. I had main responsibility for the development project during physical design
8. I had main responsibility for the development project during implementation

5.3.7.9 Information Systems Maturity:

IS organisational maturity is defined as the overall status of the MIS function within the organisation. Prior studies used various criteria to measure information systems maturity. Most of them, however, failed to perform validity and reliability tests on the

measuring instrument (Mahmood and Becker, 1984). This study measures IS maturity using the nine-item instrument developed by King and Sabherwal (1992). This measure was based on previous scales of organisational maturity (Benbasat, Dexter, and Mantha, 1980) and was able to display high levels of reliability and validity. Respondents were asked to describe nine aspects of the overall information systems environment of their organisation on a 6-point scale ranging from no extent to very great extent (table 5-14).

Table 5-14: Items used to measure IS maturity

1. Extent to which IS staff are informed about business plans and operations
2. Extent to which top management is informed about information technology
3. Extent to which information technology impacts the organisation's performance
4. Extent to which IS supports many functions in the organisation
5. Extent to which information technology is available throughout the organisation's premises
6. Extent to which IS performance is evaluated in terms of contribution to the organisation's overall objectives rather than cost savings
7. Extent to which IS planning is formalised
8. Extent to which IS planning takes the business plans into consideration
9. Extent to which top management is involved in IS planning

5.3.7.10 Computer Training

Computer training is defined as the extent of computer related training from various internal and external sources. Based on (Igbaria et al, 1995; Nelson and Cheney, 1987) respondents were asked to report the extent of computer-related training they had received from four sources: their company, vendor training, college courses, and self-training. For each source, this was measured using a five-point scale ranging from (1) = "non" to (5) = "extensive".

5.3.7.11 User Experience:

User experience is defined in terms of length of EIS use and the level of computer use skills. In accordance with Thompson et al. (1994), the user experience was measured using two dimensions: length of EIS use and level of computer use expertise. Length of EIS use was measured by asking the users to state the amount of time for which they had used the EIS (Leidner and Elam, 1995). Computer expertise was measured

by asking the respondents to rate their overall skills in using computers to perform their job on a 5-point scale (very low, low, average, high, and very high).

The following section presents the statistics used to analyses the research data and the rationale behind such choice.

5.3.8 Statistical Analysis:

The level of measurement affects the appropriateness of the statistics that can be used in analysing the data. Almost all of the measures used in this study are, *basically* and *strictly speaking*, ordinal. Yet, though most psychological scales are basically ordinal, researchers can with considerable assurance often assume equality of interval and use parametric statistics in analysing such data (Kerlinger, 1986 p. 402). This is especially true in prior IS research on which this study is based (e.g., Davis et al, 1989; Venkatesh, 1999; Srivihok, 1999; Torkzadeh et al, 1999). Thus to uncover the effect of treating ordinal measurements as though they were interval measurement on the results of the hypotheses testing, this study will use both parametric and non-parametric measures of relations to test the research model hypotheses.

The first step of the statistical analysis is the assessment of the quality of the research instrument. The evaluation of the quality of the research instrument includes testing for the effect of common method variance and testing the validity and reliability of the research variables' measures. To test for a possible effect of common method variance, a single factor analysis of all the constructs items assumed to be measuring different constructs is conducted. As the measures used in this study have been formally validated in previous methodological studies or have been used previously in more than one empirical study, the measures are assessed only for internal consistency reliability and construct validity. Descriptive statistics such as frequencies, means, and standard deviations are then calculated to provide an overview of the research variables and to allow a wider interpretation of the findings.

Following Bergeron et al (1995), correlation and multiple regression analyses are used to test the individual hypotheses and to estimate the predictive validity of the research model. Firstly, both the parametric measure of relation; Pearson's product-moment coefficient of correlation (r), and the non-parametric; Spearman rank-order coefficient of correlation (rho) are used to test the magnitude and direction of the relationships

suggested by the hypotheses. Secondly, multiple regression analysis is used to test the causal relationship between each group of independent variables (predictors) and the corresponding dependent variable. Regression analysis also determines the relative importance of each of the independent variables in explaining the variance in the dependent variable.

5-4 Conclusion:

This chapter discussed the major issues concerning the research methodology of the present study. It started by re-stating the research hypotheses included in the proposed model. A discussion of different types of research design and the rationale behind selecting a cross-sectional mail survey for this study was then presented. The chapter then described the pilot study, the sampling procedure, the survey response rate, and the analysis of the non-response bias.

To define the boundaries, to which the results of this study may be generalised, a detailed account of the characteristics of the respondents is presented. The respondents are described in terms of industry type, number of employee, and annual turnover. The results show that the study covers varying types of industries and that 79% came from large organisations employing more than 500 employees.

The respondents are also described in terms of their age, gender, educational level, and years in current position, managerial level, and functional area. The data analysis reveals that the respondents' average age is 39 years, most of them are males, and university graduates. The respondents represent both senior and middle management levels and varying functional areas. The chapter then presented the definitions and measures of the research variables.

Finally the statistical data analysis techniques used to test the research hypotheses were introduced. The next chapter presents the results of the descriptive analysis of the research variables included in the model. To indicate the quality of the measures, the chapter also reports on the validity and reliability analyses of the measurement instruments used in the research.

Chapter 6

Evaluation of the Measurement Scales and Descriptive Analyses

6.1 Introduction:

This chapter presents the results of the preliminary data analyses prior to the introduction of the results of the research model's hypotheses testing in the next chapter. The chapter starts with an evaluation of the measurement scales of the research variables. Almost all the variables in this research are measured using multiple item scales that have been tested and validated in previous studies. The adequacy of such scales for measuring the research variables will be evaluated using validity and reliability analyses. The chapter then provides descriptive analyses of the research data to reveal their basic features. The results will provide useful insights pertaining to the status of EIS usage and the profile of the user beliefs related to the system and to the impact of its use. They will also present a description of some individual and organisational attributes that may shape the perceptions of EIS users in British organisations.

6.2 Evaluation of the Quality of the Research Instrument

The evaluation of the quality of the research instrument includes testing for the effect of common method variance and testing the validity and reliability of the research variables' measures. The measures used in this study have been formally validated in previous methodological studies or have been used previously in more than one empirical study, thus the measures used in this study are assessed only for internal consistency reliability and construct validity.

6.2.1 Testing for the Effect of Common Method Variance:

This study used a single source of information, a questionnaire, to measure all the research variables. This procedure could result in spurious relationships between variables due to the *halo effect*, that is a tendency to rate an object in the constant direction of a general impression of the object (Kerlinger, 1986). Thus, to test for a possible effect of common method variance, a single factor analysis of all the constructs items assumed to be measuring different constructs was conducted. The emergence of one factor solution would suggest that the items be related because of a common method (Igbaria et. al., 1997). The principal components factor analysis of

the questionnaire items yielded 12 components explaining 69% cumulated variance (appendix 6-1). The first factor explained 21% of the total variance, hence indicating that the responses were not affected by the use of a single measurement instrument.

6.2.2 Assessment of Internal Consistency Reliability and Construct Validity:

Reliability is the accuracy or precision of a measuring instrument, it also refers to the stability or consistency of an operational definition (Kerlinger, 1986, p. 405). Reliability is concerned with answering the questions: "Is the operational definition measuring "something" consistently and dependably, what ever that "something" may be?" (Singleton et al, 1993, p. 114). Another approach to the definition of reliability is the "relative absence of errors of measurement in a measuring instrument" (Kerlinger, 1986, p.405). For example a measure of perceived usefulness will be considered reliable to the extent is able to hit the true score of actual levels of perceived usefulness. This study assesses reliability by examining the consistency of responses across all items (internal consistency reliability). The criteria given by Nunnally (1978) that an alpha reliability 0.7 or more is considered an adequate reliability coefficient was applied to determine the adequacy of the reliability coefficients obtained for each measure.

Validity is concerned with answering the question: "are we measuring what we think we are measuring? The emphasis in this question is on what is being measured" (Kerlinger, 1986 p. 417). It also refers to the goodness of fit between an operational definition and the concept it purported to measure (Singleton et al, 1993, p115). Kerlinger (1986) suggests that factor analyses is a powerful and indispensable method of construct validation. It allows the researcher to identify the extent to which a factor analytical solution is consistent with a priori theoretical expectations. The ratio of sample size to biggest number of items included in a measure (216:9) was well above the minimum of 10:1 suggested for factor analysis by Kerlinger (1986).

In determining the relative importance and significance of the factor loading of each item the guidelines recommended by Hair et al. (1998) was used. Thus loading greater than 0.3 is considered significant, loading greater than 0.4 is more important and loading of 0.5 or greater is considered as very significant. An average extracted variance of 0.50 or more was used to assess the average variance extracted from all

measures (Igbaria et al., 1995). Following is the results of the validity and reliability tests of the research variables.

6.2.2.1 EIS use:

Table 6-1 shows the results of the internal consistency reliability analysis of the EIS use measure. To the extent that an item measures the same thing as the total score does, to this extent the item is valid. The results indicate that all the three items are significantly correlated with the total item and that the alpha reliability will not improve if any of the items is deleted.

Table 6-2 depicts the results of the factor analysis used to test the construct validity of the EIS use measure. The results show that the three items of EIS use fall under one dimension with loading exceeding 0.5. This dimension explains 62% of the total variance in the variable. Thus the measure was able to demonstrate appropriate level of construct validity.

Table 6-1: reliability analysis of EIS use items

EIS use items	Correlated item-total correlation	Alpha if item deleted
1. Frequency of EIS use	0.44	0.70
2. EIS-information use	0.57	0.52
3. Time of EIS use	0.56	0.50
Reliability Coefficients 3 items Alpha = 0.69 Standardised item alpha = 0.70		

Table 6-2: Component matrix of EIS use measure

EIS use items	Loading
	Component 1
1. Frequency of EIS use	0.719
2. EIS-information use	0.824
3. Time of EIS use	0.826

Extraction Method: Principal Component Analysis, one component extracted.

6.2.2.2 Perceived usefulness:

Table 6-3 depicts the results of the alpha reliability analysis. It shows that the four items used to measure PU are highly correlated with the total score and that all the items contribute to the overall reliability score of the measure.

Factor analysis of PU items (table 6-4) reflects that they all fall into one factor. This factor explains 82.79% of the total variance in the measure thus demonstrating an excellent level of construct validity. Those results are consistent with findings of prior studies that tested the quality of the PU measure.

Table 6-3: Reliability analysis of perceived usefulness measure

Perceived usefulness items	Correlated item-total correlation	Alpha if item deleted
1. Increase job productivity	0.8228	0.9131
2. Make it easier to do the job	0.8072	0.9182
3. Enhance effectiveness on the job	0.8778	0.8955
4. Improve job performance	0.8414	0.9080
Reliability Coefficients 4 items Alpha = .9300 Standardised item alpha = .9300		

Table 6-4: Component matrix of PU measure

PU items	Loading
	Component 1
1. Increase job productivity	0.900
2. Make it easier to do the job	0.892
3. Enhance effectiveness on the job	0.934
4. Improve job performance	0.913

Extraction Method: Principal Component Analysis, one component extracted.

6.2.2.3 Perceived ease of use:

Table 6-5 depicts the results of the alpha reliability analysis of PEOU. It shows that the four items used to measure PEOU are highly correlated with the variable's total score and that all the items contribute to the overall reliability score of the measure. Factor analysis of perceived ease of use items (table 6-6) reflects that they all fall into one factor. The resulting factor explains 72.25% of the total variance in the measure, thus demonstrating an excellent level of construct validity. Those results are consistent with findings of prior studies that tested the quality of the PEOU measure.

Table 6-5: reliability analysis of perceived ease of use measure

Perceived usefulness items	Correlated item-total correlation	Alpha if item deleted
1. Easy to interact with	0.5520	0.8256
2. Flexible	0.4869	0.8498
3. Easy to learn	0.5817	0.8206
4. Easy to become skilful	0.5375	0.8375
Reliability Coefficients 4 items Alpha = 0.87 Standardised item alpha = 0.87		

Table 6-6: Component matrix of PEOU measure

PEOU items	Loading
	Component 1
1. Easy to interact with	0.860
2. Flexible	0.824
3. Easy to learn	0.871
4. Easy to become skilful	0.845

Extraction Method: Principal Component Analysis.
1 component extracted.

6.2.2.4 Perceived information quality:

Table 6-7 depicts the results of the alpha reliability analysis of perceived information quality. It shows that the nine items used to measure information quality are highly correlated with the variable's total score and that all the items contribute to the overall reliability score of the measure.

Table 6-7: Reliability analysis of perceived information quality measure

Perceived information quality items	Correlated item-total correlation	Alpha if item deleted
1. The input is presented in a useful format	0.6489	0.9006
2. The information is clear	0.6184	0.9026
3. The information is accurate	0.5665	0.9058
4. The EIS provide the critical information	0.7535	0.8932
5. The information is sufficient	0.7131	0.8960
6. The information is up-to-date	0.6409	0.9027
7. The information is in time	0.7164	0.8958
8. The reports are about exactly what is wanted	0.7496	0.8931
9. The information is precise	0.7886	0.8900
Reliability Coefficients 9 items Alpha = 0.9082 Standardised item alpha = 0.9089		

Factor analysis of information quality items (table 6-8) reflects that they all fall into one factor. The factor explains 58.18% of the total variance in the measure, thus demonstrating an adequate level of construct validity.

Table 6-8: Component matrix of perceived information quality measure

Perceived information quality items	Loading
	Component 1
1. The input is presented in a useful format	0.734
2. The information is clear	0.702
3. The information is accurate	0.645
4. The EIS provide the critical information	0.819
5. The information is sufficient	0.783
6. The information is up-to-date	0.711
7. The information is in time	0.774
8. The reports are about exactly what is wanted	0.821
9. The information is precise	0.851

Extraction Method: Principal Component Analysis.

1 component extracted.

6.2.2.5 User involvement:

Table 6-9 depicts the results of the alpha reliability analysis of involvement measure. It shows that the six items used to measure involvement are highly correlated with the variable's total score and that all the items contribute to the overall reliability score of the measure.

Table 6-9: Reliability analysis of user involvement measure

User involvement items	Correlated item-total correlation	Alpha if item deleted
1. Important/unimportant	0.8107	0.9448
2. Essential/nonessential	0.8314	0.9435
3. Fundamental/trivial	0.8427	0.9409
4. Of concern/of no concern to me	0.8600	0.9393
5. Relevant/irrelevant to me	0.8650	0.9389
6. Matters/doesn't matter to me	0.8838	0.9362
Reliability Coefficients 6 items Alpha = 0.9500 Standardised item alpha = 0.9515		

Factor analysis of information quality items (table 6-10) reflects that they all fall into one factor. The factor explains 80.52% of the total variance in the measure, thus demonstrating a high level of construct validity.

Table 6-10: Component matrix of user involvement measure

User involvement items	Loading
	Component 1
Important/unimportant	0.865
Essential/nonessential	0.881
Fundamental/trivial	0.892
Of concern/of no concern to me	0.908
Relevant/irrelevant to me	0.912
Matters/doesn't matter to me	0.924

Extraction Method: Principal Component Analysis.

1 components extracted.

6.2.2.6 Subjective Norm:

Table 6-11 depicts the results of the alpha reliability analysis of subjective norm measure. It shows that the responses concerning the four items of the measure are highly correlated with the variable's total score and that all the items contribute to the overall reliability score of the measure.

Table 6-11: Reliability analysis of subjective norm measure

Subjective norm items	Correlated item-total correlation	Alpha if item deleted
1. Superiors	0.5146	0.7719
2. Colleagues	0.7375	0.6627
3. Subordinates	0.6572	0.6997
4. Information systems staff	0.4854	0.7903
Reliability Coefficients 4 items Alpha = 0.7857 Standardised item alpha = 0.7899		

Factor analysis of information quality items (table 6-12) reflects that they all fall into one factor. The factor explains 61.84% of the total variance in the measure, thus demonstrating a high level of construct validity.

Table 6-12: Component matrix of user involvement measure

Subjective norm items	Loading
	Component 1
1. Superiors	0.731
2. Colleagues	0.884
3. Subordinates	0.830
4. Information systems staff	0.686

Extraction Method: Principal Component Analysis.

1 components extracted.

6.2.2.7 User Participation:

Table 6-13 depicts the results of the alpha reliability analysis of participation measure. It shows that the items of the measure are highly correlated with the variable's total score and that all the items contribute to the overall reliability score of the measure. Factor analysis of participation items (table 6-14) reflects that they all fall into one factor. The factor explains 65.43% of the total variance in the measure, thus demonstrating a good level of construct validity.

Table 6-13: Reliability analysis of participation measure

Participation items	Correlated item-total correlation	Alpha if item deleted
Leader of the EIS project team?	0.7695	0.9112
Responsibility for estimating development costs of EIS?	0.7697	0.9111
Responsibility for requesting additional funds to cover unforeseen time/costs overruns?	0.7079	0.9159
Responsibility for selecting the software and/or the hardware needed for EIS?	0.5974	0.9245
Responsibility for the success of EIS?	0.7373	0.9137
Responsibility for the development project during system definition	0.7495	0.9126
Responsibility for the development project during physical design	0.7863	0.9098
Responsibility for the development project during implementation	0.8182	0.9070
Reliability Coefficients 8 items Alpha = 0.9233 Standardised item alpha = 0.9236		

Table 6-14: Component matrix of participation measure

Participation items	Loading
	Component 1
Leader of the EIS project team?	0.834
Responsibility for estimating development costs of EIS?	0.829
Responsibility for requesting additional funds to cover unforeseen time/costs overruns?	0.777
Responsibility for selecting the software and/or the hardware needed for EIS?	0.674
Responsibility for the success of EIS?	0.800
Responsibility for the development project during system definition	0.820
Responsibility for the development project during physical design	0.850
Responsibility for the development project during implementation	0.871

Extraction Method: Principal Component Analysis.
1 components extracted.

6.2.2.8 Information systems maturity:

Table 6-15 depicts the results of the alpha reliability analysis of the IS maturity measure. It shows that all the items are correlated with the variable's total score and that they all contribute to the overall reliability score of the measure. The alpha reliability of 0.81 reflects a good level of internal consistency and thus allows the addition of the nine items.

Table 6-15: Reliability analysis of IS maturity measure

IS maturity items	Correlated item-total correlation	Alpha if item deleted
1. IS staff are informed about business plans and operations	0.5158	0.7901
2. Top management is informed about information technology	0.4912	0.7931
3. Information technology impact the organisation's performance	0.3940	0.8038
4. IS support many functions in the organisation	0.4313	0.8002
5. Information technology is available throughout the organisation's premises	0.4400	0.7990
6. IS performance is evaluated in terms of contribution to the organisation's overall objectives rather than cost savings	0.4767	0.7968
7. IS planning is formalised	0.5819	0.7814
8. Extent to which IS planning takes the business plans into consideration	0.6602	0.7708
9. Top management is involved in IS planning	0.5589	0.7843
Reliability Coefficients 9 items Alpha = 0.8102 Standardised item alpha = 0.8096		

However, the factor analysis (table 6-16) reflects that the measure of IS maturity underlies two factors. The first factor includes items 1, 2, 5, 6, 7, 8, and 9, while items 3 and 4 load higher on factor 2. The table shows that the two items under the second factor show secondary loading greater than 0.5 on the first factor as well. According to Doll and Torkzadeh (1988), factors with multiple significant loading may be an excellent measure of the overall construct. As the main concern in this study is to understand the impact of overall maturity on user beliefs, the nine items were combined together to calculate the total IS maturity score.

Table 6-16: Component matrix of IS maturity measure

IS maturity items	Loading Component 1	Loading Component 2
1. IS staff are informed about business plans and operations	0.643	-0.280
2. Top management is informed about information technology	0.617	-0.308
3. Information technology impact the organisation's performance	0.506	0.599
4. IS support many functions in the organisation	0.555	0.647
5. Information technology is available throughout the organisation's premises	0.556	0.479
6. IS performance is evaluated in terms of contribution to the organisation's overall objectives rather than cost savings	0.606	-0.254
7. IS planning is formalised	0.709	-0.142
8. IS planning takes the business plans into consideration	0.774	-0.108
9. Top management is involved in IS planning	0.686	-0.322

Extraction Method: Principal Component Analysis, 2 components extracted.

6.3 Descriptive Analysis:

The descriptive data analysis involves examining the central tendency, dispersion, and frequency distribution of the research variables. This section presents the descriptive statistics and frequency distribution, where appropriate, of the variables included in the research model. Those are EIS use, perceived usefulness, perceived ease of use, perceived information quality, user involvement, subjective norm, facilitating conditions, participation, IS maturity, computer training, and user experience.

6.3.1 EIS Usage:

Table 6-17 depicts the descriptive statistics of the three measures of EIS usage, those are: (1) Frequency of using EIS on a 5-point scale ranging from never, less than once a month, monthly, weekly, to daily. (2) Time spent using EIS in an average week (average number of hours per week). (3) Use of EIS-based information accessed directly and/or through intermediaries (measured as a percentage of total information needs satisfied through various sources in the organisation).

As different scales were used to measure the three use dimensions, the total score of EIS use is calculated as a standardised average of the three components. The results (table 6-18) show that the average frequency of using EIS is 3.15, which means that

on average EIS is used on a monthly basis (i.e., 1-3 times/month). A study of senior and middle managers use of EIS in the USA, reported an average use of 1 to 4 times per week (Leidner and Elam, 1995), this implies that USA managers use their EIS more often than their counterparts in the UK.

Table 6-17: Descriptive statistics of EIS use measures

EIS use dimensions	Mean	Standard deviation	Minimum	Maximum
Frequency of EIS use	3.1540	0.7316	1.00	4.80
Time of use (hrs/week)	6.5021	6.5642	0.00	37.00
EIS information use (total)	44.23%	0.2582	0%	100%

Table 6-18 shows the descriptive statistics of the frequency of EIS use to perform a set of activities. When calculating the average frequency of EIS use, three items were excluded from the measure, namely, the use of EIS to access company news, competitive, and national and international information. The reason was that most of the respondents chose "never" as an answer and thus those actions were considered unrepresentative of the way EIS is used.

Table 6-18 Valid percentages of the frequency of using EIS:

Frequency of using EIS to:	Never	Less than once/month	Monthly	Weekly	Daily	Total
Read standard reports	1.4%	5.6%	42.8%	30.7%	19.5%	100%
Request customised reports	21.5%	22.9%	25.7%	24.3%	5.6%	100%
Retrieve key performance indicators	9.7%	9.3%	39.4%	31.0%	10.6	100%
Detect trends	12.6%	15.8%	45.6%	21.9%	4.2%	100%
Ad hoc querying of databases	12.7%	13.7%	20.3%	32.5%	20.8%	100%
Access company news	88.4%	1.9%	3.7%	2.8%	3.2%	100%
Monitor competitors information	85.2%	6.5%	4.6%	2.8%	0.9%	100%
Monitor national / international information	85.2%	4.2%	6.0%	2.8%	1.9%	100%

Also the results (table 6-17) shows that EIS is used on average for 6.5 hours/week with a standard deviation of 6.56, which reflects a wide variance in the time of use from a minimum of zero to a maximum 37 hours/week. Thus, the number of hours

were re-coded into a scale from one = less than 1 hr/week, to six = 20 hrs and more/week. A study of managers' use of computer systems in Greece found that the average use is 9.6 hours/week (Valhos and Ferrat, 1995). Thus it also seems that British managers spend less time on the use of their EIS. Table 6-17 also shows that EIS is used to satisfy an average of 44% of the information needs of the managers while the rest are satisfied through personal contacts and paper-based reports.

Table 6-19: Levels of use of EIS-based information and other information sources

Information sources available to the EIS user	Mean	Std. Deviation	Minimum	Maximum
EIS information use (direct)	29.08%	0.2283	0%	100%
EIS information use (indirect)	15.15%	0.1653	0%	80%
Paper-based sources	29.97%	0.1888	0%	85%
Personal contacts	25.27%	0.1906	0%	90%

Table 6-19 describes the managers' use of various information sources available to them. The results show that EIS is used both directly and indirectly to satisfy the executive information needs. The direct use of EIS is shown to satisfy 29% of the information needs, while the use of EIS output prepared by others provides 15% of the information needs. The results also show that paper-based sources still provide a significant 29% of the executive' information. While 25% of the managers' information came from personal contacts.

These results are consistent with previous research on managers' use of computer based information. Many executives today still depend on paper summaries or information provided by administrative staff while those who use personal computers often receive data heavily manipulated by others in the organisation (Bartholomew, 1997). The dependence on personal contacts may be explained by the nature of this source as a rich communication channel able to convey both hard and soft information (Watson et al, 1997).

6.3.2 Perceived Usefulness

Perceived usefulness is calculated as the average score of the responses on four statements concerning the user's opinion of EIS usefulness in enhancing his/her performance on a 5-point scale. Table 6-20 shows that EIS is perceived as highly useful in enhancing the performance of its users as reflected by the high mean of the individual items and the total perceived usefulness score. Reported perceived

usefulness for the four items ranged from the low of one to the maximum of five. The standard deviation (0.7672) reflects low dispersion of the responses around their mean.

Table 6-20 Descriptive statistics of perceived usefulness

Items of Perceived usefulness	Mean	Standard deviation	Minimum	Maximum
Increase job productivity	4.0000	0.8408	1	5
Make it easier to do the job	4.0972	0.8097	1	5
Enhance effectiveness on the job	4.0046	0.8212	1	5
Improve job performance	3.8935	0.9010	1	5
Total score	3.9988	0.7672	1	5

In a study on EIS use in British organisations, Fitzgerald and Murphy (1994) reported that the mean rating of benefits provided, measured on a scale from one to five, was 3.2 reflecting that the executives under study did not rate the benefits of EIS very highly. Such difference may be attributed to the earlier timing of the study as well as the size of the sample that covered 21 respondents from four case organisations.

6.3.3 Perceived Ease of Use:

Perceived ease of use is calculated as the average score of the respondents' perception concerning the amount of effort associated with using the EIS on a five-point scale. The results (table 6-21) show that EIS is perceived to be moderately easy to use as depicted by the mean of the individual items and the total score (3.655). The reported levels of perceived ease of use vary from 1 to 5 with a standard deviation of 0.702, indicating a low variance of the responses around the mean.

Table 6-21 Descriptive statistics of perceived ease of use

Items of perceived ease of use	Mean	Standard deviation	Minimum	Maximum
1. Easy to interact with	3.8750	0.8001	1	5
2. Flexible	3.4630	0.9040	1	5
3. Easy to learn	3.5880	0.8472	1	5
4. *Easy to become skilful*	3.6944	0.7528	1	5
Total PEOU score	3.6551	0.7019	1	5

In a prior study on British organisations Fitzgerald and Murphy (1994) found that the average perceived ease of use was only 3.6, indicating a moderate level of ease of use

(on a scale from 1 to 5). Another study of 32 Finnish and English users reported an average score of 4.5 (on a 5 point scale) indicating that the users view EIS as extremely easy to use (Partanen and Savolainen, 1995).

6.3.4 Perceived Information Quality:

Perceived information quality is calculated as the average of nine items concerning various aspects of EIS output quality on a scale from one to five. The aggregated score reflects the overall user satisfaction with different indicators of EIS information quality. The results of the reliability analyses (table 6-7) have provided support to the internal consistency of the information quality items. Also the factor analysis of the information quality items (table 6-8) has shown that they represent one factor and thus could be aggregated.

For perceived information quality, a mean of 3.5653 indicates that on average EIS is perceived to be providing satisfactory output around 62.5% of the times (Table 6-22). The low standard deviation (0.7078) is an indicator of relatively low dispersion of the responses around that average. These results reflect that the perceptions of EIS information quality are greater than average. However, it also shows that there is a need to direct more effort to improve the current quality of the information provided to the users.

Table 6-22 Descriptive statistics of information quality

Items of perceived information quality	Mean	Standard Deviation	Minimum	Maximum
Output is presented in a useful format	3.5139	0.8239	1	5
Information is clear	3.7269	0.8209	1	5
Information is accurate	4.1019	0.8063	1	5
EIS provide critical information	3.4583	0.8935	1	5
Information is sufficient	3.3611	0.9146	1	5
Information is up-to-date	3.7639	1.0975	1	5
Information is in time	3.6435	1.0288	1	5
Reports are about what is wanted	3.2454	0.9741	1	5
Information is precise	3.2731	0.9857	1	5
Total information quality score	3.5653	0.7078	1	5

6.2.5 User Involvement:

User involvement is calculated as the average score of the respondents' evaluation of the importance and relevance of EIS to their job using six adjectives. The reported involvement items ranged between a minimum of one and a maximum of seven. The results in table 6-23 show that users believe that, on average, the overall involvement

is 5.79, which indicates that the users perceive the EIS as being highly relevant and important to their job. The standard deviation of 1.02 reflects a relatively low dispersion of the values around their mean.

Table 6-23 Descriptive statistics of user involvement

Items of user involvement	Mean	Standard deviation	Minimum	Maximum
Important/unimportant	5.8194	1.1851	1	7
Essential/nonessential	5.5278	1.2829	1	7
Fundamental/trivial	5.6389	1.1244	1	7
Of concern/of no concern to me	5.9491	1.0706	1	7
Relevant/irrelevant to me	5.9491	1.0551	1	7
Matters/doesn't matter to me	5.8611	1.1161	1	7
Total involvement score	5.7901	1.0211	1	7

6.3.6 Subjective Norm:

Table 6-24 depicts the descriptive statistics of the respondents reported levels of subjective norm (SN) concerning their usage of EIS on a 5-point scale ranging from a minimum of one referring to very low extent to a maximum of five referring to very high extent. The mean subjective norm is "3.2" reflecting a moderate extent of perceived social pressures to make use of the EIS. The standard deviation "0.87" shows that the respondents are not widely dispersed around their mean score.

Table 6-24: Descriptive statistics of subjective norm

Items of subjective norm	Mean	Standard deviation	Minimum	Maximum
Superiors	3.3704	1.1131	1	5
Colleagues	3.3889	1.0462	1	5
Subordinates	3.0000	1.1123	1	5
Information systems staff	3.0930	1.1803	1	5
Total subjective norm score	3.2149	0.8717	1	5

6.3.7 Facilitating Conditions:

This variable measures the number of capabilities available in the EIS provided to each respondent. As depicted by table 6-25, the number of EIS capabilities varies from a minimum of one to a maximum of eight. On average the EIS provide from four to five capabilities to the user with a standard deviation of 1.56.

Table 6-25: Descriptive statistics of facilitating conditions

Variable Name	Mean	Standard deviation	Minimum	Maximum
Facilitating conditions	4.5278	1.5579	1.00	8.00

Table 6-26 shows the frequency and the percentage of each EIS capability. The results show that 99.1% of the users have standard reports in their EIS. Simple analysis tools such as spreadsheets are available in 82.4% of the systems. Unscheduled query is available in the EIS of 76.4% of the respondents. Drill down capability is provided by 69.4% of the EIS systems. 53.7% of the EIS in the sample provide their users with exception reporting and 27.8% have what-if analysis and modelling capabilities. Only 25.0% of the respondents have access to external databases and 19.0% have soft data available on their EIS.

A recent study in the UK reported on the standard functionality provided by EIS systems (Perera, 1995). Standard reporting was available in 81% of the EIS systems, exception reporting in 62%, drill-down analyses in 86%, ad hoc reporting in 33%, internal text (soft data) in 24%, and external text (soft data) in 24%.

Table 6-26: Frequency of reported availability of EIS functions

EIS Functions	Frequency (N=216)	Valid Percent
Standard Reporting	214	99.1%
Ad-hoc / Unscheduled Query	165	76.4%
External Databases	54	25.0%
Simple Analyses/ Spreadsheets	178	82.4%
Exception Reporting	116	53.7%
Drill-down Capability	150	69.4%
What-if Analyses / Modelling	60	27.8%
Soft data e.g. news, forecasts	41	19.0%

These results provide support to the findings of the present study. Perera also found that the amount of external information available in the EIS databases was less than 20% in 76% of the respondents. This reflects that access to external information and soft data is still a scarce occurrence in the UK systems.

6.3.8 User Participation:

User participation was measured using eight questions concerned with the user responsibility in developing and implementing the EIS available to him/her in his current position. The answer was either "Yes" = 1 or "No" = 0. The final score is the total number of activities, in which the user has participated, which ranges between zero, meaning no participation and eight, meaning participation in all the activities.

Table 6-27: Descriptive statistics of total user participation score

Variable name	Mean	Standard deviation	Minimum	Maximum	Mode
Participation	2.9028	3.0871	0.00	8.00	0

Table 6-27 shows that on average the respondents reported participation in less than 3 out of eight activities. On the other hand a standard deviation of 3.0871 indicates a wide spread of the reported participation round the mean.

Table 6-28 depicts the frequency of performing each of the eight activities, and the mean of each of the individual items. The most common value (mode) across the participation items is the zero. Thus for all of the participation activities, the respondents reported more times of no participation than of yes. Also the average of each of the eight participation items was less than 0.5 reflecting a low level of participation on all of the items.

Table 6-28: Frequency distribution and mean of participation items

Participation items: (1 = yes, 0 = No Number of respondents =216)	Frequency of "Yes"	Valid Percent	Mean	Mode
Were you the leader of the EIS project team?	66	30.6%	0.306	0.00
Did you have the responsibility for estimating development costs of EIS?	70	32.4%	0.324	0.00
Did you have the responsibility for requesting additional funds to cover unforeseen time/costs overruns?	75	34.7%	0.347	0.00
Did you have the responsibility for selecting the software/hardware needed for EIS?	80	37.0%	0.370	0.00
Did you have the responsibility for the success of EIS?	107	49.5%	0.495	0.00
I had main responsibility for the development project during system definition	71	32.9%	0.329	0.00
I had main responsibility for the development project during physical design	70	32.4%	0.324	0.00
I had main responsibility for the development project during implementation	88	40.7%	0.407	0.00

6.2.9 Information Systems Maturity:

MIS maturity is the average score of nine items corresponding to different aspects of the MIS function on a 6-point scale ranging from no extent to a very great extent. Since none of the respondents rated any of the items as non-existing, the first two ratings, that is no extent and very low extent, were grouped together and the scale was transformed into a five-point scale.

Table 6-29 shows that the total maturity score has a mean of 3.3836 and a standard deviation of 0.567 hence reflecting a moderate overall maturity status. This result is consistent with a previous study (Wastell and Sewards, 1995) on small to middle sized manufacturing organisations in the UK, which revealed that the firms exhibited

intermediate degree of IS maturity. However, 79% of the respondents in the present study came from large size organisations, thus the comparison with Wastell and Seward should be applied with caution.

The analyses of the IS maturity items show that the physical availability of IT throughout the organisation, the extent of IS support of different functions in the organisation, and the impact of IS on the performance of the organisation have a relatively higher average.

Table 6-29: Descriptive statistics of information systems maturity

IS Maturity items	Mean	Standard deviation	Minimum	Maximum
1. IS staff are informed about business plans and operations	2.8774	0.9409	1	5
2. Top management is informed about information technology	3.1402	0.8386	1	5
3. Information technology impact the organisation's performance	3.9720	0.7438	1	5
4. IT support many functions in the organisation	3.9953	0.8550	1	5
5. Information technology is available throughout the organisation's premises	4.0935	0.8111	1	5
6. IS performance is evaluated in terms of contribution to overall objectives rather than cost savings	2.7570	1.0556	1	5
7. IS planning is formalised	3.2477	0.9190	1	5
8. IS planning takes the business plans into consideration	3.2430	0.9228	1	5
9. Top management is involved in IS planning	3.1355	0.9619	1	5
Total IS maturity score	3.3836	0.5673		

On the other hand, items related to the bases of evaluating IS performance (item 6), the IS/IT managerial knowledge and top management involvement (items 1 and 2, and 9), and extent of IS planning formalisation and alignment with the organisations plans (items 7 and 8) received lower ratings.

6.3.10 Computer Training:

This study measures the users' computer-related training from different sources. Nord and Nord (1994) reported an increasing emphasis on formal training at both

educational and corporate level compared to studies conducted in the past, however users still view company training as less than adequate. Table 6-30 depicts the mean, standard deviation, minimum, and maximum statistics for each of the sources. The results show that reported computer self-training is highly rated (4.14) with 0.77 standard deviation around the mean, the minimum self training is 2 reflecting that all of the respondent have at least some level of self training. On the contrary college training was rated as low with an average of 1.7083 and a standard deviation of 0.9898.

Table 6-30: Descriptive statistics of computer-related training

Variable name	Mean	Standard deviation	Minimum	Maximum
Self Training	4.1435	0.7732	2.00	5.00
Company Training	2.7222	0.9031	1.00	5.00
Vendor Training	2.4074	0.9792	1.00	5.00
College Training	1.7083	0.9898	1.00	5.00

This result could be explained by the nature of the sample as it consists of senior and middle management levels with average age of 39 years. Company training and vendor training were both rated between little and average, hence reflecting a modest role of formal training as a source of computer related learning for the managers.

Table 6-31: Frequency of users having training from the different sources

Training source	Frequency (out of 216)	Percentage
Self Training	216	100%
Company Training	199	92.1%
Vendor Training	175	81%
College Training	94	44.5%

The results of this study show that the largest source of training in the British companies under investigation is on the job self-training. Table 6-31 describes the frequency and percentage of users receiving any level of training from the different sources. In a study of end-user training in the USA, Nord and Nord (1994) revealed that nearly 75% of all respondents receive computer training sponsored by their companies. Additionally, nearly 65% of the total respondents had received some formal computer training from schools or college. The higher age and organisational level of the respondents in the present study may explain the low percentage of college training compared to that detected by Nord and Nord (1994).

6.3.11 User Experience:

Two dimensions were used to measure user experience: length of EIS use and level of computer use skill. Table 6-32 shows that the average period of using EIS is 4.5 years with a minimum of zero and a maximum of 18 years and a standard deviation of 3.38. On the other hand the respondents reported an average computer use skill of 4.58, which corresponds to high computer use skill.

Table 6-32: Descriptive statistics of user experience dimensions

Variable name	Mean	Standard deviation	Minimum	Maximum
Years of EIS Use	4.5832	3.3766	0.00	18.00
Computer Use Skill	4.0556	0.7196	2.00	5.00

6.4 Conclusion:

This chapter presented the preliminary data analyses, which included the evaluation of the quality of the measures and the descriptive analysis of the research variables.

The data was tested for the effect of common method variance and was not found to display a one-factor solution as shown by the emergence of 12 distinct factors from the principle component analysis. Given that most of the measures used in this study were based on previously validated and tested measures, the study tests only the construct validity and the internal consistency reliability of the measures.

Table 6-33: Summary of the reliability and validity analyses

Variable name	Reliability coefficient	Variance extracted
EIS use	0.70	62.6%
Perceived usefulness	0.93	82.79%
Ease of use	0.87	72.25%
Perceived Information quality	0.91	58.18%
Involvement	0.95	80.52%
Subjective norm	0.79	61.84%
Participation	0.92	65.43%
IS maturity	0.81	55.43%

Table 6-33 summarises the results of the reliability and factor analysis. The internal consistency reliability of all constructs exceeded the recommended 0.7 level, except for EIS use. The alpha reliability for the EIS use measure was 0.70 which lies on the border of the acceptable reliability level and the total variance extracted from the use

factor analyses was 62%. The reliability of perceived usefulness was 0.93, which is consistent with findings of previous research, while the total variance extracted was 83%.

The internal consistency for perceived ease of use was 0.87 and the variance extracted was 72%. Information quality had 0.91 alpha and variance extracted of 58%. For involvement the reliability was 0.95 and the variance extracted equal to 81%. Subjective norm had a reliability of 0.79 and an extracted variance of 62%. Participation had a reliability of 0.92 and an extracted variance of 65%. Finally maturity had 0.81% reliability. The factor analysis for IS maturity revealed a two factor solution with 55% extracted variance. Thus it could be concluded that the measures show good levels of internal consistency and construct validity.

The results show that the respondents reported moderate levels of EIS use as indicated with the average use index reflecting the three use criteria i.e. frequency of use, use-time/week, and EIS-based information use as a percentage of the overall information needs. The results show that EIS is used rarely to access external information or company news, while the main uses are reading standard reports and ad hoc querying of databases.

The descriptive statistics of the respondent's beliefs concerning the usefulness of EIS indicate that it is perceived to be highly useful in enhancing their work performance. The EIS is also perceived to be easy to use. The results show that EIS output is rated as being able to meet the users' quality expectations around 62.5% of the time. Additionally, the respondents displayed a high level of involvement with the EIS and rated it as highly relevant and important. Subjective norm concerning the use of EIS was rated slightly above average reflecting moderate support by important others to the use of EIS.

Concerning EIS facilitating conditions, the results showed that on average the users have between four and five EIS functions, that standard reporting is available to almost all of the respondents and that soft data is the least available of the functions. The respondents reported low levels of participation in the design and development responsibilities of their EIS. However the reported levels of participation may have been low because the respondents were not in their positions when the systems were first introduced.

The findings concerning IS maturity show a moderate maturity status of the IS function. While, items related to IT spread to various functions and its effect on the organisation's performance received higher ratings, items concerning the IT/managerial knowledge and the evaluation of the system in terms of their impact on the organisational goals rather than cost savings received lower ratings.

The results also show that the respondents rated self-training as being high and college training as being low, while the company and vendor training were rated as being around average. The respondents also reported an average of 4.5 years of EIS use. Finally, the results show that the respondents reported high levels of computer use skill. The next chapter will present the results of the research model hypotheses testing.

Chapter 7

Results of Hypotheses Testing

7.1 Introduction

This chapter presents the results of testing the hypotheses embedded in the research model. The results are arranged into five groups corresponding to the five dependent variables described in the research model. Those are: (1) EIS use, (2) perceived usefulness, (3) perceived ease of use, (4) perceived information quality, and (5) user involvement. Firstly, results of the correlation analyses are presented. The hypotheses are tested using parametric correlation; Pearson (r), and non-parametric correlation; Spearman (rho). Secondly, results of the stepwise multiple regression analysis used to simultaneously asses the causal relationships between the independent variables and the dependent measure and to determine the relative importance of each of the independent variables in explaining the variance in the dependent variable are reported.

7.2 Results of the Correlation Analysis

This section describes the results of the correlation analysis used to test the individual research model hypotheses with 0.05 as the significance level. It starts by testing the hypotheses related to EIS use, then perceived usefulness, perceived ease of use, perceived information quality, and finally user involvement.

7.2.1 Results of Testing the Hypotheses Related to EIS Use:

According to the research model perceived usefulness, perceived ease of use, information quality, subjective norm, and facilitating conditions (EIS sophistication) are hypothesised to positively influence the use of EIS. Table 7-1-1 and 7-1-2 depicts the results of testing the hypotheses that describe the expected relationships between these variables. Following is a discussion of the correlation analyses results.

7.2.1.1 The Relationship between Perceived Usefulness and EIS Use:

Hypothesis H1-1 suggests that perceived usefulness positively influences EIS use. The results of the Pearson correlation "r" (table 7-1-1) and the Spearman correlation "rho" (table 7-1-2) show that there is a strong significant positive relationship between perceived usefulness and use ($r = 0.558$ at $p < 0.001$ and $rho = 0.542$at $p < 0.001$).

Table 7-1-1 Pearson's (r) correlation between use and its determinants

EIS Use Determinants	EIS Use (total score)	Frequency of Use	Duration of Use	Information Use
Perceived Usefulness (H1-1)	0.558**	0.454**	0.411**	0.479**
P (N)	0.000 (216)	0.000 (216)	0.000 (216)	0.000 (216)
Perceived Ease of Use (H1-2)	0.380**	0.227**	0.321**	0.337**
P (N)	0.000 (216)	0.000 (216)	0.000 (216)	0.000 (216)
Information Quality (H1-3)	0.494**	0.333**	0.390**	0.442**
P (N)	0.000 (216)	0.000 (216)	0.000 (216)	0.000 (216)
Involvement (H1-4)	0.422**	0.335**	0.337**	0.344**
P (N)	0.000 (216)	0.000 (216)	0.000 (216)	0.000 (216)
Subjective Norm (H1-5)	0.503**	0.270**	0.443**	0.446**
P (N)	0.000 (216)	0.000 (216)	0.000 (216)	0.000 (216)
Facilitating Conditions (H1-6)	0.423**	0.412**	0.311**	0.323**
P (N)	.000 (216)	.000 (216)	.000 (216)	.000 (216)

*Correlation is significant at the 0.05 level (1-tailed).
** Correlation is significant at 0.01 level (1-tailed test).

Table 7-1-2 Spearman's (rho) correlation between use and its determinants

EIS Use Determinants	EIS Use (total score)	Frequency of Use	Duration of Use	Information Use
Perceived Usefulness (H1-1)	0.542**	0.397**	0.450**	0.471**
P (N)	0.000 (216)	0.000 (216)	0.000 (216)	0.000 (216)
Perceived Ease of Use (H1-2)	0.375**	0.249**	0.317**	0.330**
P (N)	0.000 (216)	0.000 (216)	0.000 (216)	0.000 (216)
Information Quality (H1-3)	0.448**	0.258**	0.395**	0.410**
P (N)	0.000 (216)	0.000 (216)	0.000 (216)	0.000 (216)
Involvement (H1-4)	0.397**	0.271**	0.348**	0.342**
P (N)	0.000 (216)	0.000 (216)	0.000 (216)	0.000 (216)
Subjective Norm (H1-5)	0.472**	0.270**	0.438**	0.218**
P (N)	0.000 (216)	0.000 (216)	0.000 (216)	0.001 (216)
Facilitating Conditions (H1-6)	0.424**	0.401**	0.353**	0.322**
P (N)	.000 (216)	.000 (216)	.000 (216)	.000 (216)

*Correlation is significant at the 0.05 level (1-tailed).

** Correlation is significant at 0.01 level (1-tailed test).

This result implies that the increase in the users' perceived usefulness of using EIS is associated with an increase in the degree of the use of EIS. The results also show a significant positive correlation between perceived usefulness and the three use components, i.e. frequency of EIS use, duration of use, and the consumption of EIS-based information. These results suggest that when manager perceive the use of EIS as being useful in enhancing their work performance, they use the system more frequently, for longer intervals, and a bigger percentage of their information needs is satisfied through its output. Thus, according to the correlation analyses, H1-1 is accepted.

7.2.1.2 The Relationship between Perceived Ease of Use and EIS Use:

Hypothesis H1-2 predicts that perceived ease of use positively influences the degree of EIS use. The correlation analyses (Table 7-1-1 and 7-1-2) indicate that perceived ease of use has a significant positive relationship with EIS use ($r = 0.380$ at $p< 0.001$ and rho = 0.375 at $p< 0.001$). This suggests that the more the users perceive their EIS to be easy to use, the more likely they will show higher levels of its use. Thus more user-friendly systems would be expected to lead to higher levels of utilisation than less user-friendly ones.

The results also reflect a significant positive correlation between ease of use and all of the three use components i.e. frequency of EIS use, duration of use, and the consumption of EIS-based information. This suggests that higher perceptions of EIS ease of use may lead to more frequent use, for longer periods of time, and to higher dependence on the system as a source of information. Therefore, according to the correlation analyses, H1-2 is accepted.

7.2.1.3 The Relationship between Perceived Information Quality and EIS Use:

Hypothesis H1-3 predicts that EIS information quality positively influences EIS use. The correlation analyses results (tables 7-1-1 and 7-1-2) provide significant support to this hypothesis. Perceived information quality was found to have a strong positive relationship with EIS usage ($r = 0.494$ at $p< 0.001$ and rho = 0.448 at $p< 0.001$). This implies that higher level of perceived EIS information quality; in regards of EIS information accuracy, relevance, clarity, completeness, precision, and updating; is associated with higher levels of systems utilisation.

This relation is reflected in a significant positive correlation between information quality and all of the three use components i.e. frequency of EIS use, duration of use, and the consumption of EIS-based information. This suggests that if the system is believed to provide high quality information, it may be used more often, for longer, and the users will depend on it more for satisfying their information needs. Therefore, according to the correlation analyses, H1-3 is accepted.

7.2.1.4 The Relationship between User Involvement and EIS Use:

Hypothesis H1-4 suggests that user involvement with the EIS positively influences its use. The results (tables 7-1-1 and 7-1-2) indicate a significant positive relation between involvement and use ($r = 0.422$ at $p < .001$, and $rho = 0.397$ $p < .001$). This implies that users who hold more positive beliefs concerning the importance and relevance of the system to their job, will show higher levels of utilisation.

This relation is reflected in a significant positive correlation between involvement and all of the three use components i.e. frequency of EIS use, duration of use, and the consumption of EIS-based information. This suggests that EIS with which users are more involved may be used more frequently, for longer, and will be used more in satisfying the users information needs. Thus, according to the correlation analyses, H1-4 is accepted.

7.2.1.5 The Relationship between Subjective Norm and EIS Use:

According to hypothesis H1-5, subjective norm positively influences EIS use. The results (tables 7-1-1 and 7-1-2) show significant support for this relationship ($r = 0.503$, $p < 0.001$ and $rho = 0.472$ at $p < 0.001$). Thus it could be concluded that the increase in the perceived social support for the utilisation of the EIS encourages higher levels of the system's usage.

This relation is reflected in a significant positive correlation between subjective norm and all of the three use components i.e. frequency of EIS use, duration of use, and the consumption of EIS-based information. These results imply that the users who believe that important work group members (superiors, subordinates, colleagues, and IS staff) expect them to use EIS will tend to use the systems more frequently, for longer, and may depend more on it as a source of satisfying their information needs. Thus, according to the correlation analyses, H1-5 is accepted.

7.2.1.6 The Relationship between Facilitating Conditions and EIS Use:

Hypothesis H1-6 predicts that the increase in facilitating conditions will lead to higher levels of EIS utilisation. Tables 7-1-1 and 7-1-2 show that facilitating conditions measured in terms of the availability of EIS capabilities was found positively related to EIS use ($r = 0.423$, $P < 0.001$ and $rho = 0.424$ $P < 0.001$). This relation is reflected in a significant positive correlation between facilitating conditions and all of the three use components i.e. frequency of EIS use, duration of use, and the consumption of EIS-based information. This leads to the conclusion that providing managers with more capabilities in their EIS may encourage using the system more frequently, for longer, and for satisfying a bigger portion of their information needs. Therefore, according to the correlation analyses, H 1-6 is accepted.

To summarise, the correlation analysis results provided support to the hypotheses that EIS use is positively related to perceived usefulness, perceived ease of use, perceived information quality, user involvement, subjective norm, and facilitating conditions. Later in this chapter the causal relationship between EIS use and these six variables will be tested using multiple regression analysis.

7.2.2 Results of Testing the Hypotheses Related to Perceived Usefulness:

According to the research model, perceived ease of use, perceived information quality, user involvement, subjective norm, and facilitating conditions are expected to positively influence perceived usefulness. Tables 7-2-1 and 7-2-2 show the results of testing the hypotheses that describe the expected relationships between these variables. Following is a discussion of the results of the correlation analyses.

7.2.2.1 The Relationship between Perceived Ease of Use and Perceived Usefulness:

Hypothesis H2-1 predicts that perceived ease of use will positively influence perceived usefulness. The results of the Pearson correlation r (table 7-2-1) and the Spearman correlation rho (table 7-2-2) provide support to this relation ($r = 0.350$ at $p<0.001$, and $rho = 0.363$ at $p<0.001$). Thus it could be concluded that the increase in the perceived ease of use of the EIS is associated with an increase in the system's perceived usefulness. This means that EIS usability could enhance its perceived functionality. Therefore, according to the correlation analyses, H2-1 is accepted.

Table 7-2-1 Pearson's correlation between PU and its hypothesised determinants

Perceived Usefulness Determinants	Correlation Coefficient (r)	P (N)
Perceived Ease of Use (H2-1)	0.350**	0.000 (216)
Information Quality (H2-2)	0.518**	0.000 (216)
Involvement (H2-3)	0.581**	0.000 (216)
Subjective Norm (H2-4)	0.461**	0.000 (216)
Facilitating Conditions (H2-5)	0.321**	0.000 (216)

*Correlation is significant at the 0.05 level (1-tailed).

**Correlation is significant at the 0.01 level (1-tailed).

Table 7-2-2 Spearman's correlation between PU and its hypothesised determinants

Perceived Usefulness Determinants	Correlation Coefficient (rho)	P (N)
Perceived Ease of Use (H2-1)	0.363**	0.000 (216)
Information Quality (H2-2)	0 .423**	0.000 (216)
Involvement (H2-3)	0 .555**	0.000 (216)
Subjective Norm (H2-4)	0 .414**	0.000 (216)
Facilitating Conditions (H2-5)	0 .292**	0.000 (216)

*Correlation is significant at the 0.05 level (1-tailed).

**Correlation is significant at the 0.01 level (1-tailed).

7.2.2.2 The Relationship between Perceived Information Quality and Perceived Usefulness:

According to hypothesis H2-2, perceived information quality positively influences perceived usefulness. The results (tables 7-2-1 and 7-2-2) provide strong support to the relationship between information quality and usefulness ($r = 0.518$, $p < 0.001$ and rho =0 .423 at $p < 0.001$). This implies that an increase in the users' beliefs in the quality of the information provided by the EIS is associated with an increase in their beliefs in the usefulness of using the system in supporting their work. Therefore, according to the correlation analyses, H2-2 is accepted.

7.2.2.3 The Relationship between User Involvement and Perceived Usefulness:

Hypothesis H2-3 predicts that user involvement with EIS will positively influence its perceived usefulness. The results (tables 7-2-1 and 7-2-2) show a strong positive relationship ($r = 0.581$, $p < 0.001$ and rho = 0.555, $p < 0.001$) between the two variables. This finding means that positive beliefs in the relevance and the importance

of the EIS for the user's work are associated with higher perceptions of the usefulness of using it. Therefore, according to the correlation analyses, H2-3 is accepted.

7.2.2.4 The Relationship between Subjective Norm and Perceived Usefulness:

Hypothesis H2-4 predicts that subjective norm concerning the use of EIS will positively influence its perceived usefulness. The result (tables 7-2-1 and 7-2-2) provide significant support to the relationship between subjective norm and perceived usefulness ($r = 0.461$, $p < 0.001$and rho = 0.414, $p< 0.001$). Hence it could be concluded that the increase in the perceived social support for the use of EIS is associated with higher beliefs in the usefulness of using of the system. Alternatively, potential users who carry higher believes in that important others expect them to use the system will tend to have higher perceptions of the usefulness of its use. Therefore, according to the correlation analyses, H2-4 is accepted.

7.2.2.5 The Relationship between Facilitating Conditions and Perceived Usefulness:

Hypothesis H2-5 suggests that the facilitating conditions will positively influence perceived usefulness. The results (tables 7-2-1 and 7-2-2) show a significant positive relationship between the two variables ($r = 0.321$, $p< 0.001$ and rho= 0.292, $p< 0.001$). This finding implies that the increase in the EIS capabilities available to the users enhances their perceptions of the usefulness of using the system in supporting their work activities. Therefore, according to the correlation analyses, H2-5 is accepted.

To summarise, the correlation analysis results presented in this section aimed to test the research model hypotheses concerned with the determinants of perceived usefulness. The data provided support to the hypotheses that EIS use is positively related to perceived ease of use, EIS information quality, user involvement, subjective norm, and facilitating conditions. Later in this chapter the causal relationship between those five independent variables and perceived usefulness will be tested using multiple regression analysis.

7.2.3 Results of Testing the Hypotheses related to Perceived Ease of Use:

The third group of hypotheses describes the expected relationship between participation, information systems maturity, computer training, and use experience (length of EIS use and computer use skill) and perceived ease of use. Table 7-3-1 and

7-3-2 show the results of testing the hypotheses that describe the expected relationships between these variables. Following is a discussion of the results.

7.2.3.1 The Relationship between Participation and Ease of Use:

According to hypothesis H3-1, participation in the development of EIS is expected to positively influence EIS perceived ease of use. The results of the correlation analyses (tables 7-3-1 and 7-3-2) show a significant positive relation between participation and ease of use ($r = 0.130$, $p< 0.05$, and $rho = 0.189$, $p< 0.01$). This means that the increase in the number of EIS development activities in which the users have participated is associated with an increase in their perceptions of the ease of use of the EIS. Therefore, according to the correlation analyses, H3-1 is accepted.

Table 7-3-1 Pearson's correlation between PEOU and its hypothesised determinants

Ease of Use Determinants	Correlation Coefficient (r)	P (N)
User Participation (H3-1)	0.130*	0.028 (216)
IS Maturity (H3-2)	0.161**	0.009 (214)
Computer Training (H3-3)	-0.008	0.452 (216)
Length of EIS Use (H3-4a)	0.141*	0.020 (211)
Computer Use skill (H3-4b)	0.278**	0.000 (216)

*Correlation is significant at the 0.05 level (1-tailed).

**Correlation is significant at the 0.01 level (1-tailed).

Table 7-3-2 Spearman's correlation between PEOU and its hypothesised determinants

Ease of Use Determinants	Correlation Coefficient (rho)	P (N)
User Participation (H3-1)	0.189**	0.003 (216)
IS Maturity (H3-2)	0.153*	0.013 (214)
Computer Training (H3-3)	0.005	0.470 (216)
Length of EIS Use (H3-4a)	0.132*	0.028 (211)
Computer Use skill (H3-4b)	0.282**	0.000 (216)

*Correlation is significant at the 0.05 level (1-tailed).

**Correlation is significant at the 0.01 level (1-tailed).

7.2.3.2 The Relationship between IS Maturity and Ease of Use:

Hypothesis H3-2 suggests that the overall information system maturity will have a positive influence on EIS perceived ease of use. The results of the Pearson correlation r (table 7-3-1) and the Spearman correlation rho (table 7-3-2) show a significant

positive correlation between ease of use and IS maturity ($r = 0.161$, $p < 0.01$ and rho= 0.153, $p < 0.05$). This implies that the increase in the organisational maturity of the IS function enhances the development of higher perception concerning the ease of use of the EIS by the individual users. Therefore, according to the correlation analyses, H3-2 is accepted.

7.2.3.3 The Relationship between Computer Training and Ease of Use:

According to H3-3 computer training will positively influence perceived ease of use. The results (tables 7-3-1 and 7-3-2) do not provide support to this hypothesis. This means that the overall computer-related training from different sources is not related to the users' perceptions of the EIS ease of use. Therefore, according to the correlation analyses, H3-3 is rejected.

7.2.3.4 The Relationship between User Experience and Ease of Use:

According to the research model the user's experience is measured from two dimensions, length of EIS use, which reflects the familiarity with the EIS, and the user skill in using computers which reflects the computing background generally. Following are the results of testing the two hypotheses related to the relationship of each of those dimensions with EIS perceived ease of use.

7.2.3.4a Length of EIS Use:

According to H3-4a length of EIS use will have a positive influence on the users' perceptions concerning the ease of its use. The correlation results (tables 7-3-1 and 7-3-2) show a significant positive relationship between length of EIS use and the perceptions of ease of use ($r = 0.141$, $p < 0.05$ and rho = 0.132, $p < 0.05$). Thus it could be concluded that users who have used EIS for longer periods of time would tend to have higher perceptions of the ease of its use. Therefore, according to the correlation analyses, H3-4a is accepted.

7.2.3.4b Computer-Use Skill:

Hypothesis H3-4b suggests that computer use skill positively influences perceived ease of use. The results (tables 7-3-1 and 7-3-2) show a significant positive correlation between the users' self-rated expertise in using computers and EIS perceived ease of use ($r = 0.278$, $p < 0.001$ and rho = 0.282, $p < 0.001$). This implies that users who consider themselves as skilful in using computers in performing their job will hold

higher beliefs in the ease of use of the EIS available to them. Therefore, according to the correlation analyses, H3-4b is accepted.

To summarise, the correlation analysis results presented in this section aimed to test the research model hypotheses concerned with the determinants of perceived ease of use. The data analyses provide support to the hypotheses that ease of use is positively related to participation in EIS development, IS maturity, length of EIS use, and computer use expertise. On the other hand no significant relationship was detected between computer training and ease of use. Later in this chapter, multiple regression analysis will be used to test the causal relationship between the four significantly related independent variables and ease of use.

7.2.4 Results of Testing the Hypotheses related to Perceived Information Quality:

The fourth group of hypotheses describes the expected relationship between participation, information systems maturity, computer training, and user experience (length of EIS use and computer use skill) and perceived information quality. Tables 7-4-1 and 7-4-2 show the correlation analyses results used to test the related hypotheses. Following is a discussion of the results.

7.2.4.1 The Relationship between Participation and Perceived Information Quality:

Hypothesis H4-1 suggests that the user participation in the EIS development activities positively influence EIS information quality. Tables 7-4-1 and 7-4-2 show that information quality has a significant positive relationship with participation ($r = 0.169$, $p < 0.01$ and rho $= 0.176$, $p < 0.01$). This result implies that the user participation in more activities during the development and implementation of EIS could results in higher perceptions of the quality of the EIS information. Therefore, according to the correlation analyses, H4-1 is accepted.

7.2.4.2 The Relationship between IS Maturity and Perceived Information Quality:

Hypothesis H4-2 predicts that information system maturity will positively influence EIS information quality. Tables 7-4-1 and 7-4-2 show that there is a significant positive relationship between EIS perceived information quality and IS maturity ($r = 0.311$, $p < 0.001$, and rho $= 0.340$, $p < 0.001$). This finding leads to the conclusion that the increase in the overall maturity of the IS function is associated with an increase in

the EIS information quality. Therefore, according to the correlation analyses, H4-2 is accepted.

Table 7-4-1 Pearson's correlation between information quality and its determinants

Information Quality Determinants	Correlation Coefficient (r)	P (N)
User Participation (H4-1)	0.169**	0.006 (216)
IS Maturity (H4-2)	0.311**	0.000 (216)
Computer Training (H4-3)	0.071	0.150 (216)
Length of EIS Use (H4-4a)	0.081	0.121 (211)
Computer Use skill (H4-4b)	0.046	0.252 (216)

*Correlation is significant at the 0.05 level (1-tailed).

**Correlation is significant at the 0.01 level (1-tailed).

Table 7-4-2 Spearman's correlation between information quality and its determinants

Information Quality Determinants	Correlation Coefficient (rho)	P (N)
User Participation (H4-1)	0.176**	0.005 (216)
IS Maturity (H4-2)	0.340**	0.000 (216)
Computer Training (H4-3)	0.105	0 .062 (216)
Length of EIS Use (H4-4a)	0.094	0.086 (211)
Computer Use skill (H4-4b)	0.083	0.111 (216)

*Correlation is significant at the 0.05 level (1-tailed).

**Correlation is significant at the 0.01 level (1-tailed).

7.2.4.3 The Relationship between Computer Training and Perceived Information Quality:

According to hypothesis H4-3 computer-related training will have a positive influence on perceived information quality. The results (tables 7-4-1 and 7-4-2) show no significant relationship between training and information quality. Hence, the finding of this study implies that general computer-related training will have no influence on the user's rating of the EIS information quality. Therefore, according to the correlation analyses, H4-3 is rejected.

7.2.4.4 The Relationship between User Experience and Perceived Information Quality:

7.2.4.4a Length of EIS Use:

According to hypothesis H4-4a length of EIS use will have a positive influence on EIS information quality. The results (tables 7-4-1 and 7-4-2) show no significant relationship between length of EIS use and information quality. This finding implies that the length of EIS use will have no influence on the users' beliefs concerning the quality of the EIS information and hence it could be concluded that using EIS for longer will not help create more positive perception of the quality of its output. Therefore, according to the correlation analyses, H4-4a is rejected.

7.2.4.4b Computer Use Skill:

Hypothesis H4-4b suggests that computer use expertise will have a positive influence on the perceptions of EIS information quality. The results (table 7-4-1 and 7-4-2) show no significant relationship between length of EIS use and information quality. This finding implies that the increase in the expertise of EIS users in using computer will have no influence on their beliefs concerning the quality of the EIS information. Hence EIS users with higher computer skills will not hold higher perception of the EIS information quality. Therefore, according to the correlation analyses, H4-4b is rejected.

To summarise, the correlation analysis results aimed to test the hypotheses concerned with the determinants of perceived information quality provided support to the hypotheses that information quality is positively related to participation in EIS development and IS maturity. However, no significant relationship was detected between information quality and ease of use, computer training, length of EIS use, and computer use expertise. Later in this chapter, multiple regression analysis will be used to test the causal relationship between information quality and the two variables that showed significant correlation with it.

7.2.5 Results of Testing the Hypotheses Related to User Involvement:

The fifth group of hypotheses describe the expected relationship between participation, information systems maturity, computer training, user experience (length of EIS use and computer use skill) and involvement. Table 7-5-1 and 7-5-2

shows the results of testing the hypotheses that describe the expected relationships between these variables. Following is a discussion of the results.

7.2.5.1 The Relationship between Participation and User Involvement:

According to the research model, hypothesis H5-1 suggests that the user participation in the development of the EIS will positively influence the involvement with the system. The results (tables 7-5-1 and 7-5-2) show that a positive correlation exists between participation and involvement ($r = 0.170$ at $p< 0.001$ and $rho = 0.156$ at $p< 0.05$). Hence, it could be concluded that the more the users participate in the development of the EIS the more they will held positive believes concerning the relevance and importance of the system to their job. Therefore, according to the correlation analyses, H5-1 is accepted.

Table 7-5-1 Pearson's correlation between involvement and its determinants

Involvement Determinants	Correlation Coefficient (r)	P (N)
User Participation (H5-1)	0.170**	0.006 (216)
IS Maturity (H5-2)	0.071	0.150 (216)
Computer Training (H5-3)	-0.040	0.279 (216)
Length of EIS Use (H5-4a)	0.067	0.167 (211)
Computer Use Skill (H5-4b)	-0.089	0.098 (216)

*Correlation is significant at the 0.05 level (1-tailed).

**Correlation is significant at the 0.01 level (1-tailed).

Table 7-5-2 Spearman's correlation between involvement and its determinants

Involvement Determinants	Correlation Coefficient (rho)	P (N)
User Participation (H5-1)	0.156*	0.011 (216)
IS Maturity (H5-2)	0.063	0.178 (216)
Computer Training (H5-3)	-0.035	0.305 (216)
Length of EIS Use (H5-4a)	0.081	0.119 (211)
Computer Use Skill (H5-4b)	-0.054	0.216 (216)

*Correlation is significant at the 0.05 level (1-tailed).

**Correlation is significant at the 0.01 level (1-tailed).

7.2.5.2 The Relationship between IS Maturity and Involvement:

The model hypothesises that the maturity of the information systems function will have a positive influence on the users involvement with the EIS (H5-2). The results

(tables 7-5-1 and 7-5-2) show that there is no significant correlation between IS maturity and involvement. This means that the overall maturity of the information systems function in the organisation does not enhance users' beliefs concerning the importance and relevance of specific IS applications such as EIS. Therefore, according to the correlation analyses, H5-2 is rejected.

7.2.5.3 The Relationship between Computer Training and Involvement:

According to hypothesis H5-3 computer-related training will positively influence user involvement with EIS. The results (tables 7-51 and 7-5-2) show that there is no significant correlation between computer training and involvement. This finding implies that users who have higher levels of computer training will not have more positive beliefs concerning the relevance and importance of specific IS applications such as EIS. Therefore, according to the correlation analyses, H5-3 is rejected.

7.2.5.4 The Relationship between User Experience and Involvement:

7.2.5.4a Length of EIS Use:

Hypothesises H5-4a suggests that the length of EIS use will positively influence user involvement with EIS. The results (tables 7-5-1 and 7-5-2) show that there is no significant correlation between the length of EIS use and involvement. This result reflects that using EIS across a longer period of time is not associated with the formation of more positive beliefs concerning the relevance and the importance of the system. Hence, it could be concluded that EIS systems used for longer are not believed to be more relevant or important than those more recently used. Therefore, according to the correlation analyses, H5-4a is rejected.

7.2.5.4b Computer Use Skill:

Hypothesis H5-4b suggests that computer use expertise will have a positive influence on user involvement with EIS. However, the results depicted in tables 7-5-1 and 7-5-2 show that there is no significant correlation between the level of computer use skill and users' involvement with EIS. Hence, it could be concluded that the increase in the computer use skills of EIS users has no impact on their beliefs concerning the relevance or importance of the EIS available to them. Therefore, according to the correlation analyses, H5-4b is rejected.

To summarise, the correlation analysis results presented in this section aimed to test the research model hypotheses concerned with the determinants of user involvement. The research data provide support to the hypotheses that involvement is positively related to participation in EIS development. However, no significant relationship was detected between IS maturity, computer training, length of EIS use, computer use skill, and user involvement.

7.3 Results of Stepwise Regression Analysis:

In order to summarise the impact of the model's independent variables and to identify their relative importance in explaining the variance in the dependent variables, i.e., EIS use, perceived usefulness, perceived ease of use, perceived information quality, and user involvement, stepwise regression analysis was performed. The following section will present the results of the stepwise regression analysis. Five stepwise regression equations were run with EIS use, perceived usefulness, perceived information quality, perceived ease of use, user involvement as dependent variables. Only the independent variables that were significantly correlated with the corresponding dependent variable were further investigated in the regression analyses.

To enter the regression equation, the independent variables should meet the 0.1 significance entry level criteria. To remain in the equation the variables should have no more than 0.05 significance level. Adjusted R square measures the total variance explained in the dependent variable by all the independent variables in the equation, while standardised beta coefficients of the independent variables determine their relative importance in determining the dependent variable.

7.3.1 Prediction of EIS Use:

Based on the correlation analyses (table 7-1), the variables included into the EIS use equation were, perceived usefulness, perceived ease of use, information quality, user involvement, subjective norm, and facilitating conditions. Table 7-6 shows that, in order of importance, subjective norm, perceived usefulness, facilitating conditions, information quality, and perceived ease of use explain 47.1% of the variance in use significant at $p < 0.001$, while involvement has no significant influence on use and thus did not enter the equation. Therefore, hypotheses H1-1, H1-2, H1-3, H1-5, and H1-6 are accepted, while, hypothesis H 1-4 is rejected.

Table 7-6 Stepwise Regression Results: EIS Use Equation

1- Model Summary and Analyses of Variance:				
Multiple R	R Square	Adjusted R Square	F Ratio	Sig.
0.695	0.483	0.471	39.267**	0.000
2- Regression Coefficients of Variables in Equation:				
Variables in equation:	Standardised Beta	t	Sig. t	Tolerance
Perceived usefulness	0.248**	3.935	0.000	0.619
Subjective norm	0.273**	4.789	0.000	0.759
Facilitating conditions	0.221**	4.135	0.000	0.865
Ease of use	0.124*	2.140	0.034	0.734
Information quality	0.136*	2.106	0.036	0.590
3- Excluded Variables:				
Variables out:	Beta In	Partial Correlation	t	Sig. T
Involvement	0.055	0.060	0.870	0.385

*P≤ 0.05, **P≤ 0.01

7.3.2 Prediction of Perceived Usefulness

Based on the results of the correlation analyses (table 7-2) the variables included into the perceived usefulness regression equation were ease of use, information quality, involvement, subjective norm, and facilitating conditions.

Table 7-7 Stepwise Regression Results: Perceived Usefulness Equation

1- Model Summary and Analyses of Variance:				
Multiple R	R Square	Adjusted R Square	F Ratio	Sig.
0.699	0.489	0.476	40.134**	0.000
2- Regression Coefficients of Variables in Equation:				
Variables in equation:	Standardised Beta	t	Sig. t	Tolerance
Involvement	0.382**	6.637	0.000	0.737
Information quality	0.226**	3.609	0.000	0.623
Subjective norm	0.159**	2.769	0.006	0.739
Ease of use	0.123*	2.156	0.032	0.744
Facilitating conditions	0.103*	2.012	0.046	0.880

*P≤ 0.05, **P≤ 0.01

Table 7-7 shows that all the variables succeeded in entering the equation and were able to explain 47.6% of the total variance in perceived usefulness significant at $p < 0.001$. The standardised beta coefficients indicate that involvement is the most important determinant of perceived usefulness, followed by information quality, subjective norm, ease of use, and finally facilitating conditions. Thus the regression analyses lends further support to hypotheses H2-1, H2-2, H2-3, H2-4, and H2-5.

7.3.3 Prediction of Perceived Ease of Use:

Based on the correlation analysis (table 7-3) only user participation, IS maturity, length of EIS use, and computer use skill were included into the stepwise regression equation of perceived ease of use. The results of the regression analysis (table 7-8) indicate that length of EIS use and computer use skill showed significant influence on perceived ease of use and thus entered the equation. Both variables explained 9% of the variance in ease of use significant at level less than 0.001. According to the standardised beta coefficients, computer use skill is found to be more important than the length of EIS use in determining EIS perceived ease of use.

Table 7-8 Stepwise Regression Results: Perceived Ease of Use Equation

1- Model Summary and Analyses of Variance:				
Multiple R	R Square	Adjusted R Square	F Ratio	Sig.
0.315	0.099	0.09	11.311**	0.000
2- Regression Coefficients of Variables in Equation:				
Variables in equation:	Standardised Beta	t	Sig. T	Tolerance
Computer use expertise	0.282**	4.254	0.000	0.999
Length of EIS use	0.151*	2.287	0.023	0.999
3- Excluded Variables:				
Variables out:	Beta In	Partial Correlation	T	Sig. t
Participation	0.060	0.062	0.892	0.374
IS maturity	0.120	0.126	1.816	0.071

*P≤ 0.05, **P≤ 0.01

However, user participation and IS maturity indicated no significant influence on perceived ease of use and were excluded from the equation. Thus the regression analysis lends further support to hypotheses H3-4a and H3-4b, however it does not support hypotheses H3-1 and H3-2.

7.3.4 Prediction of Perceived Information Quality:

The results of the correlation between information quality and its hypothesised determinants (table 7-4) showed that computer training, duration of use and use skill were not related to information quality, while IS maturity and participation were significantly correlated with it. Thus only IS maturity and participation were included as predictor variables in the information quality regression equation.

Table 7-9 Stepwise Regression Results: Perceived Information Quality Equation

1- Model Summary and Analyses of Variance:				
Multiple R	R Square	Adjusted R Square	F Ratio	Sig.
0.343	0.118	0.11	14.11**	0.000
2- Regression Coefficients of Variables in Equation:				
Variables in equation:	Standardised Beta	t	Sig. T	Tolerance
IS maturity	0.305**	4.717	0.000	0.999
Participation	0.146*	2.259	0.025	0.999

*P≤ 0.05, **P≤ 0.01

Table 7-9 depicts the results of the analysis which further support the influence of IS maturity and participation on the perceived EIS information quality. Both variables were found to explain 11% of the variance in information quality significant at less than 0.0001. IS maturity were found more important than participation in determining information quality. Thus the regression analyses lends further support to hypotheses H4-1 and H4-2.

7.3.5 Prediction of User Involvement:

The results of the correlation between involvement and its hypothesised determinants (table 7-5) provided very little support to the research hypotheses. IS maturity, computer training, duration of use and use skills were not related to information quality, while only participation showed significant correlation with it. Thus only user participation was included as the predictor of involvement in the stepwise regression equation. Table 7-10 depicts the result of the analysis, which provides further support to the influence of participation on user involvement. Participation was found to explain 2.4% of the variance in involvement significant at 0.012 (table 11-1). Thus the regression analyses lends further support to hypotheses H5-1.

Table 7-10 Stepwise Regression Results: User Involvement Equation

1- Model Summary and Analyses of Variance:				
Multiple R	R Square	Adjusted R Square	F Ratio	Sig.
0.170	0.029	0.024	6.355*	.012
2- Regression Coefficients of Variables in Equation:				
Variables in equation:	Standardised Beta	t	Sig. T	Tolerance
Participation	0.17*	2.521	0.012	1.000

*P≤ 0.05, **P≤ 0.01

7.4 Conclusion:

This chapter presented the results of the statistical analysis used to test the hypotheses embedded in the research model. The first part presented the results of the hypotheses testing using correlation analyses. The second part presented the results of the hypotheses testing using stepwise multiple regression analysis. Any hypothesis that was rejected based on the absence of significant correlation between its variables was not further tested using the stepwise regression analyses. As the research hypotheses imply causal relationships rather than mere associations, a hypothesis accepted by the correlation analyses but rejected based on the regression analyses will be rejected in the overall evaluation of the model. The results of testing the research hypotheses using correlation and stepwise multiple regression analyses are summarised in table 7-11.

The first section in this chapter presents the results of testing the research hypotheses using both parametric and non-parametric correlation analyses in order to identify the impact of assuming equal intervals of the likert scale measures used in the study. The results show that the two correlation coefficients, r and rho, provided similar support or non-support to the research hypotheses. Thus it could be concluded that treating the ordinal scales as though they were interval scales and the subsequent use of parametric analyses did not result in changes in the results of the hypotheses testing.

The correlation analyses results (both Pearson' r and Spearman' rho) show that the degree of EIS use is positively related to EIS perceived usefulness, EIS perceived ease of use, EIS perceived information quality, user involvement with EIS, subjective norm, and facilitating conditions. On the other hand, results of the regression analyses show that EIS use is determined in order of importance by subjective norm, perceived

usefulness, facilitating conditions (EIS sophistication), information quality, and ease of use. However, the regression analysis indicates that the influence of involvement on EIS use is insignificant. This may mean that the correlation between involvement and use was due to their stronger correlation with a third variable, namely perceived usefulness. When such shared variance was eliminated by the stepwise regression analysis, the influence of involvement on use became insignificant. Thus, in terms of understanding the direct determinants of EIS use, the research model received significant support with five out of six hypotheses supported by the multiple regression analysis.

Table 7-11 Summary of the Results of the Hypotheses Testing

Research Model Hypotheses	Correlation Support	Regression Support
1- Hypotheses Related to EIS Use		
H1-1 Perceived usefulness positively influences use.	Yes	Yes
H1-2 Perceived ease of use positively influences use.	Yes	Yes
H1-3 Information quality positively influences use.	Yes	Yes
H1-4 User involvement positively influences use.	Yes	No
H1-5 Subjective norm positively influences use.	Yes	Yes
H1-6 Facilitating conditions positively influences use.	Yes	Yes
2- Hypotheses Related to Perceived Usefulness (PU)		
H2-1 Perceived ease of use positively influences PU.	Yes	Yes
H2-2 Information quality positively influences PU.	Yes	Yes
H2-3 User involvement positively influences PU.	Yes	Yes
H2-4 Subjective norm positively influences PU.	Yes	Yes
H2-5 Facilitating conditions positively influences PU.	Yes	Yes
3- Hypotheses Related to Perceived Ease of Use (PEOU)		
H3-1 Participation positively influences PEOU.	Yes	No
H3-2 IS maturity positively influences PEOU.	Yes	No
H3-3 Training positively influences PEOU	No	No
H3-4a Length of EIS use positively influences PEOU.	Yes	Yes
H3-4b Computer use skill positively influences PEOU.	Yes	Yes

Table 7-11 Summary of the Results of the Hypotheses Testing (Continued).

Research Model Hypotheses	Correlation Support	Regression Support
4- Hypotheses Related to Information Quality		
II4-1 Participation positively influences information quality.	Yes	Yes
H4-2 IS maturity positively influences information quality.	Yes	Yes
H4-3 Training positively influences information quality	No	No
H4-4a Length of EIS use positively influences information quality.	No	No
H4-4b Computer-use skill positively influences information quality.	No	No
5- Hypotheses Related to User Involvement		
H5-1 Participation positively influences involvement.	Yes	Yes
H5-2 IS maturity positively influence involvement.	No	No
H5-3 Training positively influences involvement	No	No
H5-4a Length of EIS use positively influences involvement.	No	No
H5-4b Computer use skill positively influences involvement.	No	No

The correlation results indicated that perceived usefulness is positively related to ease of use, information quality, user involvement, subjective norm, and facilitating conditions. On the other hand the multiple regression analysis showed that perceived usefulness is determined, in order of importance, by user involvement, perceived information quality, subjective norm, ease of use, and facilitating conditions. Thus, in terms of explaining the direct determinants of perceived usefulness, the research model received full support.

The correlation results found that perceived ease of use is positively related to user participation in EIS development, IS maturity, length of EIS use, and computer use skill, while contrary to expectations ease of use was not significantly related to computer training. On the other hand, the results of the multiple regression analysis indicated that perceived ease of use is influenced, in order of importance, by length of EIS use and computer use skill.

The correlation results indicated that perceived information quality is positively related to user participation in EIS development and levels of IS maturity, while contrary to expectations perceived information quality was not significantly related to computer training, length of EIS use, and computer use skill. On the other hand, multiple regression analysis indicated information quality is influenced, in order of importance, by IS maturity and user participation. Finally, the correlation results showed that user involvement is positively related to user participation in EIS development. On the other hand, involvement was not significantly related to IS maturity, computer training, length of EIS use, and computer use skill. On the other hand, the results of the multiple regression analysis indicated that user involvement is influenced by user participation.

In summary, the empirical results provided considerable support to the research model. Subjective norm, perceived usefulness, facilitating conditions, information quality, and ease of use were found to explain 47.1% of the variance in EIS use. User involvement, information quality, subjective norm, ease of use, and facilitating conditions were found to explain 47.6% of the variance in perceived usefulness. Length of EIS use and computer use skill were found to explain 9% of the variance in perceived ease of use. IS maturity and participation were found to explain 11% of the variance in perceived EIS information quality. Finally, participation was found to explain 2.4% of the variance in involvement.

In the next chapter the research findings are discussed and compared with results of prior studies. Recommendations for future research on EIS/IS usage and the technology acceptance model, and practical implications of the findings of the present study to EIS and information systems development and implementation practice will also be outlined.

Chapter 8

Discussion of Results and Implications for Theory and Practice

8.1 Introduction:

This chapter discusses the results of the research findings in order to illustrate how far the research objectives have been attained and to present the implications of the research findings on EIS / IT usage theory and practice. In the first part, the empirical evidence from the mail survey is compared to findings of previous studies and the research conclusions are presented. The findings are evaluated as to the extent they provide support to the proposed research model.

The second part discusses the research implications concerning the areas where the study findings could have a useful contribution for the understanding of EIS/IT utilisation. It also presents some policy and managerial implications concerning the relative influence that could be imposed on EIS use by manipulating the partially controllable or fully controllable factors found related to EIS use. The findings have the potential for offering practical guidelines to the parties interested and involved in the process of EIS utilisation. Such diagnostic tools could help to manage better the use of EIS as well as other IT applications available to managers. The chapter also identifies limitations of the study and presents suggestions for future research.

8.2 Discussion of Results:

This section presents an evaluative discussion of the research findings in the light of previous studies of EIS/IT use determinants. It starts by comparing the findings of this study concerning the determinants of EIS usage by findings of prior studies, then those related to perceived usefulness, perceived ease of use, EIS information quality, and user involvement.

8.2.1 Determinants of EIS Use

The main objective of this study is to test a behavioural model of EIS use. The model hypothesises that EIS usage is directly influenced by perceived usefulness, ease of use, information quality, involvement, subjective norm, and facilitating conditions. The correlation analysis results provide support for a positive relationship between EIS use and all the variables. However when the causal relationships between the six

independent variables and usage were tested simultaneously in the multiple regression analysis, the effect of involvement on EIS usage was found to be insignificant.

The positive influence of perceived usefulness on EIS use found in this study is supported by the results of Bergeron et al (1995). Their study was conducted on a sample of 38 executives using executive information systems and it found perceived consequences to positively influence the internalisation of use and, contrary to the present study, to have no impact on the frequency of use. This difference may be explained by the small size used by Bergeron et al. and the nature of the respondents who were mainly drawn from top management levels (33 out of the 38).

Results of previous studies on applications such as word processing (Davis et al, 1989), personal computing acceptance (Thompson et al. 1991; Igbaria et al. 1995,1997) decision support systems (Lucas et al., 1990), and e-mail (Straub et al., 1995) provide further support to the positive influence of perceived usefulness on usage. Those results highlight the importance of perceived usefulness as an antecedent to EIS/IT use. Thus systems designers must focus on the features of EIS that provide actual benefits to the users.

The study results concerning the positive influence of perceived ease of use on usage is consistent with the findings of Igbaria et al. (1997), Matheison (1991), and Thompson et al. (1991). On the other hand the regression results showed that the impact of ease of use on usage is less than that of perceived usefulness. This result confirmed findings of previous research which found perceived usefulness to be more important than perceived ease of use in determining use (Thompson et al., 1991; Davis, 1989). Thus it could be concluded that systems must be perceived as easy to use in order to get utilised, however perceived benefits are more important than ease of use in promoting higher levels of systems utilisation.

On the other hand, the findings of this study are in contradiction with the studies of Straub et al (1995) and Sjzna (1996) which found that ease of use has no direct effect on use. Those two studies reported that perceived usefulness completely mediated the influence of perceived ease of use on usage. In both studies, the simplicity of the IS application under study (e-mail and voice-mail) as well as the sample could explain the difference in the results concerning the impact of ease of use on usage.

The study findings concerning the positive impact of EIS information quality on usage is consistent with findings of a large body of research on the relationship between user satisfaction/attitudes and usage such as Baroudi et al, (1986), Lucas (1978), Robey (1979), Raymond (1985), and Khalil and Elkordy (1999). The results are also consistent with the study of Bergeron et al (1995) which found that satisfaction with information content has a positive influence on the frequency of use and on the level of EIS internalisation in the user's work. Also Leidner (1996) has shown that EIS information quality was the main determinant of frequency of EIS use. The positive impact of information quality on EIS usage is not surprising since quality of EIS information output was reported to be key to the ongoing use of EIS (Rainer and Watson, 1995). Also, information quality was found to be the most important attributes of EIS for top managers (Bergeron et al, 1991).

Although, user involvement showed a positive correlation with EIS usage, its influence on use was found insignificant when further tested using multiple regression analysis. One explanation of this contradictory finding is that the stronger relationship between involvement and perceived usefulness may have mediated the influence of involvement on EIS usage. Thus it could be concluded that user involvement influences EIS utilisation only indirectly through perceived usefulness. This result is inconsistent with that of Swanson (1974) who found that system appreciation is positively related to use.

It is important to note that the regression results do not mean that user involvement has no influence on levels of systems usage, rather it reflects that the variance in EIS use due to involvement is completely explained by perceived usefulness thus making involvement redundant in a multivariate context. Hence, researchers must be careful in interpreting the regression results because relationships among the independent variables may "mask" relationships that are not needed for predictive purposes but nevertheless present key findings (Hair et. al, 1998 p.161).

The study findings concerning the positive impact of subjective norm on usage is consistent with the findings of previous IS research, which emphasises the importance of top management support in promoting greater systems' use such as Lucas et. al. (1990), Lucas (1978), and Robey (1979). The findings are consistent with Bergeron et al (1995), Vandenbosch and Huff (1997), that tested the relationship in the context of

EIS. The findings of Hartwick and Barki (1994) and Thompson et al. (1991) also support the study results.

On the other hand the findings of this study contradict those of Davis et al. (1989) and Matheison (1991), which reported no significant relationship between subjective norm and use. A closer examination of the subjects and context of those two studies could explain such results. Both studies were applied on simple IS applications (word processing and spreadsheets) and employed a sample of university students. Moreover, Matheison (1991) gave instructions to the students that their bonus grades for the participation in the study will not be influenced by their decision to use the system. Therefore in both studies normative influences can't be expected to be strong.

On the other hand, studies that looked at the use of IT in organisational settings such as Bergeron et.al. (1995), Hartwick and Barki (1994), and Thompson et. al. (1991; 1994) found subjective norm to have significant influence on use or intention to use. Those results highlight the importance of the work group influence and social factors in determining the individual's use of information systems in the work place. They also extend the technology acceptance model to include the influence of social factors on technology acceptance behaviour.

The results of this study concerning the impact of facilitating conditions on usage is consistent with those of Bergeron, et al. (1995) which reported a positive relation between EIS sophistication (as an indicator of facilitating conditions) and use. This result emphasises the importance of providing the managers with multi-featured systems to serve their varying managerial roles and activities. Thus it could be argued that providing the user with more features in the EIS facilitates the use of the system in doing more work tasks and is therefore a conduit to higher levels of utilisation.

The research model used in this study carries the explanation of EIS use a step further by trying to identify some of the factors related to the user beliefs hypothesised to influence use. The following sections discuss the empirical evidence concerning the determinants of perceived usefulness, perceived ease of use, perceived information quality, and user involvement. Many of the relationships investigated at this level of the model were not put into empirical examination by previous studies, rather they are based on the conceptualisation of the technology acceptance model, theories from social psychology, and IS success factors literature.

8.2.2 Determinants of Perceived Usefulness

According to the model perceived usefulness is determined by perceived ease of use, perceived information quality, involvement, subjective norm, and facilitating conditions. The results of the correlation analyses showed a positive correlation between all of the five variables and perceived usefulness. The multiple regression analyses provided further support to the correlation results and showed that involvement is the most important determinant of perceived usefulness followed by EIS information quality, subjective norm, ease of use, and facilitating conditions.

The study result that EIS ease of use has a positive impact on EIS perceived usefulness is consistent with the results of a large body of research for example Adams et al (1992), Davis et al (1989), Igbaria et al (1997), Mathieson (1991), and Sjazna (1996). Also computer self-efficacy; a construct similar to ease of use, was found to explain a considerable amount of variance in perceived consequences of usage; a synonym of perceived usefulness (Compeau and Higgins, 1995). This result stresses the importance of EIS perceived ease of use in influencing the user's perceptions of the usefulness of its usage. This relationship may be explained by the notion of cost/benefit analyses, where the cost/effort involved in using the system is weighed against the benefits/usefulness derived from using it.

The findings of this study concerning the influence of perceived information quality on perceived usefulness is consistent with the results reported by Seddon and Kiew (1994) and the results of Kraemer et al (1993). Those findings also lend support to the extended model of IS success suggested by Seddon (1997) which added the construct of perceived usefulness into the Delone and Mclean (1989) model of IS success. Hence, the consideration of the impact that users' satisfaction with EIS information quality has on their perceptions of the EIS usefulness seems important for enhancing the perceived benefits of the behaviour of EIS usage.

The study finding that involvement is the most important determinant of perceived usefulness is consistent with Seddon and Kiew (1994). It is also in line with Hartwick and Barki (1994) who reported a positive influence of involvement on user attitudes that was similarly defined as perceived usefulness. These results imply that the users who hold higher beliefs concerning EIS importance and relevance to their work are likely to have higher perceptions of the usefulness of using EIS in performing their

job. This implies also that an EIS needs to be perceived as important and relevant to the user's job in order to be considered useful.

The positive influence of social factors on perceived usefulness detected by this study extends the technology acceptance model to account for the influence of social factors on behavioural beliefs. The results are consistent with Compeau and Higgins (1995) who found that encouragement of important others influence computer use outcome expectations and with Hartwick and Barki (1995) who reported that subjective norm positively influence attitudes toward IS usage. Also the findings of Igbaria et al (1995, 1997) support the existence of a direct positive relationship between management support; an important reference group; and perceived usefulness. These findings indicate that the social influences experienced by information systems' users affect their perception of the usefulness of using such systems.

The positive influence of facilitating conditions on perceived usefulness shows that providing the users with more features in the EIS raises their perception concerning the usefulness of the system. No previous study known to the researcher has provided empirical evidence concerning this relationship. However, the results provide validation of the technology acceptance model considering system sophistication as a fully controllable factor that helps to shape the users perceptions of the usefulness of EIS use. Hence, the consideration of this relationship in further studies will help identify the impact of investing in more sophisticated systems on the perceived usefulness of the system.

8.2.3 Determinants of Perceived Ease of Use

The study provides empirical evidence that participation in EIS development, IS maturity, length of EIS use, and computer use skill are positively related to perceived ease of use, on the other hand no significant relationship was detected between computer training and ease of use. When those relationships were further tested using multiple regression analysis, participation in EIS development and IS maturity showed insignificant influence on ease of use. Hence, it seems that the variance in ease of use due to participation and IS maturity is completely accounted for by computer use skill and length of EIS use.

The empirical evidence provided by the study that user participation in EIS development is positively related to ease of use comes in accordance with the

assumptions of the technology acceptance model concerning the indirect effect of external factors on use through user beliefs. It also sheds some light on one of the different ways through which user participation in systems development could enhance the success of EIS implementation. Hence it could be argued that participation could increase the user's understanding of the system resulting in raising the perceptions of ease of use. As this relationship was not investigated in previous studies, it merits further investigation by IS researchers.

The correlation analyses show a positive relationship between the information systems' function maturity and EIS perceived ease of use. This result means that users in organisations characterised by a more mature information system would tend to perceive the EIS available to them as more easy to use than users who work in organisations with less mature information systems. Although the regression results failed to support this finding, the exploratory nature of this hypothesis makes it worthy of further examination in future studies.

The absence of any relation between computer training and ease of use comes contrary to the findings of Igbaria et al (1997) in the context of personal computing. This result could be due to the impact of individual differences such as education, use experience, and years in job which were found to moderate the influence of training on perceived ease of use (Agarwal et al, 1996). The measurement of computer-related training rather than EIS-related training might also be another reason for not detecting a direct effect on ease of use. Also the moderately high levels of PEOU detected in this study may explain why computer training was not a significant contributor to EIS ease of use.

The positive impact of length of use and computer use skill on EIS ease of use is consistent with the findings of Thompson et. al. (1994) and Al-Gahtani and King (1999). Those results imply that as users become more experienced with the EIS (by using it over a longer time period), they become more familiar with its different features and will hence hold more positive perceptions of its ease of use. The result are also consistent with Rivard and Huff (1988) which found that computer use background positively influence user perceptions of the friendliness of software applications. It thus seems that EIS users who rate themselves as highly skilled in using computers in work will tend to perceive their EIS as more easy to use. Those

results imply that it is important to increase the general computer literacy of users prior to their being asked to use EIS.

8.2.4 Determinants of Perceived Information Quality

The correlation results showed that the factors related to EIS information quality were IS maturity and user participation in EIS development, while computer training, length of EIS use, and computer use skill were not significantly related to perceived information quality. The multiple regression analysis provided further support to those results and showed that IS maturity is the main determinant of information quality.

The study findings concerning the positive impact of participation on EIS information quality comes in accordance with the prior findings that user participation in systems development is key to user satisfaction (e.g., Doll and Torkzadeh, 1988; Kappleman and Mclean 1991; Elkordy, 1994; McKeen et. al., 1994). It is also consistent with the study of Srivihok (1999) where a positive correlation was detected between participation in EIS development and EIS information quality. Such findings support the conclusion of Rainer and Watson (1995) concerning the importance of managers' participation in EIS development on the implementation success of EIS.

Given the inconsistent empirical evidence of the participation-satisfaction relationship in the literature (Ives and Olson, 1984; Lei, 1994), the results of this study provide important insights concerning the impact of users' participation in EIS development on their perceptions of EIS information quality. The study results imply that user participation provides an accurate assessment of the user information needs and avoids the development of unnecessary features and thus creates higher user perception of the system's quality, which in turn was found to promote higher levels of utilisation.

The positive impact of the overall information systems organisational maturity on EIS information quality was not investigated in previous studies. However, they are consistent with the findings of other studies concerning IS maturity and user satisfaction such as Cheney and Dickson (1982), Mahmood and Becker (1985), Selim (1997) and Raymond (1990). The scarcity of empirical evidence related to such relationship and the strong influence of IS maturity on information quality detected in

this study emphasises the importance of taking into consideration the organisational context in which EIS are introduced on the output quality of such applications.

The insignificant relationship between computer training and perceptions of EIS quality contradicts the literature on the role of training in enhancing information satisfaction and use (e.g., Coe, 1996). The results of the present study is inconsistent with the findings of previous studies that indicated a positive relationship between training and satisfaction with end-user computing (e.g., Cronan and Douglas, 1990; Sanders and Courtney, 1985; Raymond, 1988). However, such studies were not applied in the context of EIS, which is expected to require minimal training. Also, the lack of correspondence between the study measure of training directed to computer use generally and the measure of information quality perceptions specific to EIS might explain the insignificant link between the two variables detected in this study.

Contrary to the research model, the results showed that length of EIS use and computer-use skill have no impact on perceived information quality. Those results are consistent with Chen (1991) who found that the length of time an executive computing system is in use does not affect the user's overall satisfaction with the system. The results are also consistent with Srivihok (1999) who found that computer experience is not related to satisfaction with EIS information quality. They are however inconsistent with other studies such as Gatian (1994) and Sanders and Courtney (1985). One explanation for user experience not influencing perceived information quality is that information quality is more a function of systems development factors, such as user participation and IS maturity than of end user computing characteristics, such as training and experience. As the literature shows mixed results concerning the relationship between user experience and information satisfaction this makes it open to further investigation.

8.2.5 Determinants of User Involvement

The study found that user involvement is positively related to user participation in EIS development, however, it was not related to IS maturity, computer training, length of EIS use, and computer use skill. The positive impact that participation has on involvement is consistent with the findings of Hartwick and Barki (1994) and Javenpaa and Ives (1991). It also provides further validation to the notions presented by Barki and Hartwick (1989) and Kappelman and Mclean (1991) that active

participation in the system development is likely to develop beliefs that the system is important and personally relevant, which will in turn influence implementation success.

The insignificant relationship between information systems maturity and user involvement means that the increase in overall maturity of the IS function is not likely to raise the user's appreciation of the EIS importance and relevance. It seems from this result that organisations with more mature information systems do not have a better chance in developing more appreciated executive information systems than those with less mature systems. While this relationship is based on the conceptualisation of the technology acceptance model, the literature does not provide any empirical evidence concerning its validity. Thus it is worthy of further investigation.

Contrary to the research model, computer training was not found to influence user involvement with EIS. Although prior research supports the role of training in creating positive user attitudes, the literature does not report any direct investigations of the relationship between training and involvement. The study operationalisation of computer-related training rather than EIS-specific training may explain the insignificant influence detected in this study. Hence, using alternative measures of training could provide better understanding of the impact of training on user involvement.

The results of this study do not support a positive relationship between EIS length of use and computer use skill on one hand and involvement with EIS on the other hand. Thus users who are more familiar with the system and who are more skilful in using computers are not likely to hold higher beliefs concerning the relevance and importance of the system. Because the literature provides no evidence concerning this relationship, it is thus worthy of further investigation.

8.2.6 Conclusion

Overall, the research model offers a good explanation of the direct determinants of EIS usage, as well as of one of its main determinants, that is perceived usefulness. However, little support was found for hypotheses related to the determinants of perceived ease of use, perceived information quality, and user involvement. Figure 8-1 depicts the results of testing the hypotheses embedded in the research model.

The paths that resemble the research hypotheses accepted by the multiple regression analysis are drawn in solid line arrows. The figure (8-1) shows that the research model hypotheses concerning the direct determinants of EIS use received considerable support from the regression analyses, where five out of six hypotheses were accepted. The results show that usage is determined in order of importance by subjective norm, perceived usefulness, facilitating conditions, information quality, and ease of use. Those five variables explained 47.1% of the variance in EIS use, which compares favourably with previous studies. The results also provide full support to the research model hypotheses dealing with the determinants of perceived usefulness. The study found that, in order of importance, user involvement, information quality, subjective norm, ease of use, and facilitating conditions explain 47.6% of the variance in perceived usefulness.

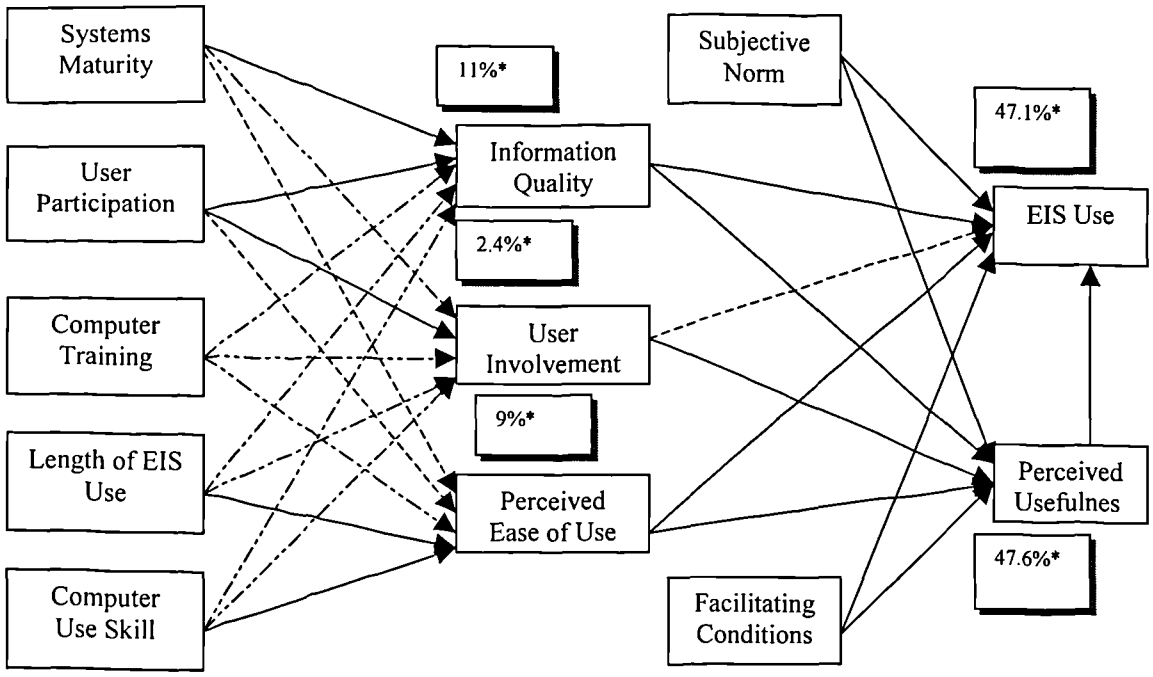


Figure 8.1 Results of the Research Model

Hypotheses supported by correlation and regression analyses ——→
Hypotheses supported by correlation analysis only ---------→
Hypotheses rejected by both of correlation and regression analyses -·-·-·-·→

* The amount of variance explained in the dependent variable by the independent variables.

However, for the research hypotheses concerned with the user beliefs regarding EIS ease of use, EIS information quality, and involvement with EIS, only five out of 15 hypotheses were supported by the regression analyses. Participation in EIS development was found to positively influence EIS information quality and ease of use. Information systems functional maturity was found to have a positive impact on EIS information quality. Contrary to expectations computer related training did not show any significant impact on ease of use, information quality, and involvement. Finally, the length of EIS use and the extent of computer use skill were found to positively influence perceived ease of use. The variance explained in ease of use, information quality, and involvement were 9%, 11%, and 2.4% respectively.

The lows support provided to the research hypotheses linking external factors to user perceptions of ease of use, information quality, and involvement are not surprising in the light of the theory of reasoned action assumption that external factors are not expected to have a consistent effect on behaviour through beliefs. However this does not diminish the importance of external factors in advancing the understanding of systems' use because when they are found to be related to behavioural beliefs they increase the understanding of the behaviour in question.

Generally, the small value of the correlation coefficients (r and rho) detected in this study together with the mixed results as well as the modest level of variance explained in the dependent variables could be attributed to the exploratory nature of the research in MIS generally and EIS research specifically. The following section will present the implications of the study results to the theory and practice of EIS/IT.

8.3 Theoretical and Practical Implications of the Results:

The results of this study should be of interest to both academic and corporate communities. On one hand, the research model extends the technology acceptance model to account for the determinants of EIS use in British organisations. The results thus contribute to the research on executive information systems as well as to the research on the technology acceptance model and information systems usage generally.

On the other hand, the results are of value to the corporate community interested in developing and implementing information systems to support the work of managers. Given the significant expenditures associated with the implementation of executive

information systems, the identification of the important determinants of EIS use will help choose the appropriate policies that should be undertaken to insure the full acceptance and continuous use of such expensive systems.

8.3.1 Contributions of the Study to IS/EIS Usage Research:

EIS literature shows the scarcity of empirical studies of the determinants of individual use of EIS, especially in the United Kingdom. Previous studies were mostly based in the USA, and adopted the perspective of senior information officers to understand users' acceptance of EIS (e.g., Bajwa, Rai, and Ramaprasad, 1998, Young and Watson, 1995). Thus, the results of this study contribute to filling the existing gap by taking on a theory-based empirical investigation of the determinants of individual usage of EIS.

The robustness of TAM was established in different information systems contexts such as e-mail and graphics (Davis, 1989), voice mail and word processors (Adams et al., 1992; Davis et al, 1989), spreadsheets (Mathieson, 1991), and group support systems (Chin and Gopal, 1995). However, TAM's ability to explain the acceptance of different systems applications should not be taken for granted.

For example, Fench (1998) used TAM to predict the use of World Wide Web. The findings showed that the model is a poor fit without the addition of self-efficacy. This warrants the need for investigating the applicability of TAM in other contexts. As no prior studies applied TAM in the context of executive information systems, the findings of this study extend the external validity of TAM to the explanation of post-implementation acceptance and on-going use of executive information systems.

The review of prior work has shown that TAM is not complete and researchers were encouraged to extend the model by including into its theoretical foundation important constructs from the IS success literature (e.g., Igbaria et al, 1995, 1997; Moore and Benbasat, 1996; and Taylor and Todd, 1995b). Thus the integrated TAM proposed by this study and the empirical validation of the model contribute to a more complete understanding of IS/EIS use behaviour and enhance the predictive power of TAM.

The results of this study provide further validation to the TAM concerning the positive influence of perceived usefulness and perceived ease of use on usage. However, in contrast to the conceptualisation of TAM, subjective norm seems to be a more important determinant of EIS use than TAM's constructs; usefulness and ease of

use. Also facilitating conditions and information quality were found to be more important determinants of use than TAM's construct perceived ease of use.

Another contribution to the research on system's acceptance/usage is the identification of some important determinants of perceived usefulness, the major determinant of systems use according to TAM and other usage models. The results show that usefulness is determined in order of importance by involvement, information quality, subjective norm, ease of use, and facilitating conditions.

Finally, despite of the substantial body of empirical evidence linking user perceptions to systems use, little is known about the factors that influence user perceptions (Agarwal et. al., 1996). The research model proposed in this study investigated the impact of four external factors, namely participation, maturity of organisational IS, computer training, and user experience on perceptions of information quality, user involvement, and perceived ease of use. Following the same model building logic, future studies may examine the impact of other external factors on users' perceptions.

8.3.2 Contributions of the Study to the Practice of IS/EIS

The results of this study have various practical implications for EIS/IS designers and implementers. Prior studies have shown that EIS use has a positive impact on executive decision-making (Leidner and Elam, 1994; Leidner and Elam, 1995) and organisational performance (Leidner, 1996). Hence, It is important to provide managers and systems developers with a better understanding of the key factors that influence EIS utilisation by executive users.

The results highlight some interesting points about the EIS currently used in British organisations. Although EIS were originally targeted at senior management, the study reveals that they are used at many levels, precisely 35.6% of the respondents came from middle management (three and four levels below the CEO). This confirms prior findings in the USA (e.g., Nord and Nord, 1996) that the use of EIS has clearly spread to middle management ranks. Thus EIS designers and implementers need to be conscious of the diverse information needs those systems should be prepared to serve.

The descriptive analyses show that, on average, executives satisfy 55.14% of their information needs from sources other than EIS, that is personal contacts and paper-based sources. This could be partly explained by users reporting that EIS information

quality is perceived as satisfactory 50% to 75% of occasions. For EIS providers this result means that the extent of EIS utilisation may be improved by providing the users with information better suited to their needs.

The users' reports of the EIS functions available to them show that external data is available for a quarter of the respondents, soft data was only provided in 19% of the existing systems, and what-if analyses and modelling capabilities were present in 27.8% of the systems. Such findings echoes the results of a prior survey in the UK (Perera, 1995). This reflects that access to external and soft information is still a scarce occurrence and that EIS are more oriented to internal reporting and control rather than towards planning and environmental scanning. Thus in developing future systems designers and implementers need to ensure the availability of those features to executive users.

On the other hand management control capabilities such as monitoring critical success factors, exception reporting and drill down capabilities were found to be the most available features in the EIS used by the respondents thus reflecting that such systems are mainly used for management control purposes. Thus EIS designers need to consider providing other EIS capabilities to prepare the system for supporting decision making, planning, communications as well as enhancement of executive's mental models.

User participation in systems design is advocated by prior EIS studies as an important key to EIS success. However, the results show a low level of users' participation in developing the EIS used by them. The fact that the study investigates rather mature systems may have contributed to this finding due to the changes in position as time passes. Nevertheless, EIS implementers should pay more attention to including the users in the responsibility of developing new systems especially since user participation was found to positively influence both EIS information quality and user involvement.

EIS designers and implementers can consider the fully or partially controllable variables in the research model to obtain practical orientations. For example, EIS designers should be aware of the relative importance of the technical capabilities of the system (e.g. provision of drill down) compared to its ease of use (e.g., flexibility), or its information content (e.g., output timeliness) in influencing the systems

utilisation and perceived usefulness. In this sense a good EIS design should be focused on providing more diverse capabilities and balance that with keeping the system easy to use and ensuring the high quality of the information content.

The study results imply that in order to influence behaviour, organisations need to expose their managers to information that will produce changes in their beliefs. Each of the user beliefs influences a different aspect of usage behaviour (Agarwal et al, 1996), and each can serve as a point of attack in the attempt to change it. Thus, persuasive communications directed at perceived usefulness, perceived information quality, perceived ease of use and involvement would produce change in the usage behaviour of existing systems and help the acceptance of new ones.

The strong influence of subjective norm on EIS use detected in this study calls for organisations to be conscious of the important role played by important referent groups; such as superiors, subordinates, colleagues and IS staff; in influencing the behaviour of the executive users. This should lead to a more global perspective, where the EIS implementation is adapted to the interpersonal contingencies of the users' intra and extra-organisational environment rather than focusing solely on the perceptions of individual users.

Additionally, the strong influence of subjective norm on perceived usefulness confirms that user beliefs are socially constructed and not only technically dependent. This means that an EIS may be perceived to be more useful if the relevant work group encourages its use. This implies that systems implementers could improve the perceived usefulness of EIS by providing a surrounding culture that encourages its use.

EIS designers and implementers need to be aware that the executives will tend to use EIS to the extent they believe it will help them improve their work performance. Thus after its initial introduction, they need to ensure that the system remains useful and to keep the users aware of its positive impact on their performance as long as it is in use. The results concerning the positive impact of perceived ease of use on usage and perceived usefulness send a message to practitioners not to forget the importance of keeping the system easy to use because this leads to higher perceived usefulness and more usage even in the post-implementation stage.

The study results imply that systems implementers could improve perceived ease of use by raising computer use skills. Also, from a practical point of view, the positive relationship between EIS length of use and perceived ease of use would mean that as users get more experienced with the system, their perceptions of its ease of use will eventually increase. Thus the EIS developer group should not worry too much about low levels of perceived ease of use during the first months of implementation because with time the users' experience will improve their perceptions of EIS ease of use.

As a facilitating condition, EIS sophistication was found to positively impact its usage and perceived usefulness due to the increasing possibility of using the system in support of different work activities. This indicates that EIS designers must increase the sophistication of their products by improving its technical capabilities, for instance by increased availability of external and soft information. Such effort is expected to create more positive perceptions of the EIS usefulness as well as to contribute directly to higher level of system utilisation.

The practical implications of the positive impact of perceived information quality on EIS usage and perceived usefulness detected in this study is that providing EIS information with higher quality will encourage more EIS use and will enhance the usefulness of the system in the eyes of its users. This emphasises the important role of EIS as a provider of high quality information to executives to help them keep on top of current conditions.

The strong positive impact of the maturity of the information systems function on EIS information quality calls EIS implementers to ensure the technological readiness of the organisation for EIS implementation. Also the results indicate user participation in EIS development is an effective policy to ensure higher quality EIS because it provides accurate assessment of the user needs and avoid the development of unnecessary features.

The results highlighted the importance of the user involvement with EIS in determining its perceived usefulness. This implies that EIS implementers need to explain the system's relevance and importance to the user's job in order to create more positive perceptions of usefulness. The results indicate that user participation in the system development is a successful policy for creating higher levels of user involvement.

The insignificant impact of computer training on ease of use implies that investing in computer training may not be the right step for improving EIS perceived ease of use. This might be explained by the fact that, generally speaking, EIS is sufficiently user friendly and easy to use that no prior computer training is really required. Additionally, EIS being a particular case of information systems, general computer training might not be the training mechanism appropriate for EIS executive users.

It is possible that such users require hands-on training or training through game playing. Prior studies suggest that training of senior executives on EIS should be of short duration and on a one-to-one base. Training must also be customised to fit the executive's background, attitude, and willingness to learn (Watson et al, 1997). Thus organisations may need to explore the efficacy of different methods of training that may be adequate for raising the managers' perceptions of EIS ease of use.

8.4 The Study Limitations

There are several limitations to this study that warrant mention. First, the population from which the data was collected (one EIS Vendor Customer list), puts some limitations on the generalisation of the results to other EIS users. Thus the generalisation of the results to other EIS users should be guided with the characteristics of the respondents on which the results are based.

Second, this study has focused only on the primary target of EIS as a tool for fulfilling executives' needs for information. However, EIS can provide other types of support. Those include enhancing management communication capabilities through e-mail and voice-mail applications that can improve the geographic reach of executives in terms of their communications with other as well as expand the ability to communicate asynchronously. Enhancing management co-ordination capabilities and executive team support with tools designed to improve the logistics and collaboration between executives, such as electronic calendars, file ticklers, and computer conferencing (Bajwa, Rai, and Ramaprasad, 1998).

Third, self reported measures were used to measure EIS usage rather than objective measures because the latter necessitate the existence of monitoring systems that keep track of the exact interactive access of the system. Despite that prior studies have depended mostly on self-reports of IS usage (Delone and McLean, 1989), there is empirical evidence that objective and self reports are two related but different facets

of the usage construct (Sjazna, 1996; Straub et al., 1995). Thus future research should try to use more objective measure of EIS use. Another strategy is to include other success measures that refer not only to use but also to the quality, individual impacts and organisational impacts of executive information systems.

Fourth, the cross-sectional survey methodology used in this study means that EIS utilisation and its antecedents were addressed at one point of time. This approach to data collection meant that the "causal" links hypothesised by the research model could not be assessed properly. Although the directions of the relationships were supported by theoretical and intuitive arguments, the research method did not test the true directions of causality. Therefore, the results should be interpreted as a more likely explanation of the associations between the variables.

Fifth, The study also addressed EIS users at the point of time the survey was administered. Users who have discontinued the use of their EIS were not included in the sample. Thus the results cannot be used to deduce requirements for EIS use vs. non use but only to suggest requirements for the EIS ongoing use.

Finally, the low correlation values detected in data analyses and the limited amount of variance explained especially in the user perception variables (ease of use, perceived information quality, and user involvement) limits the practical significance of the results. This limitation is inherent in the exploratory nature of the research on MIS generally and that on managers use of IT specifically.

8.5 Recommendations for Future Research:

Although the research model accounts for a considerable amount of the variance in the use of EIS, there is still a big proportion of the systematic variance that needs to be explained. It was argued that this level of understanding could be the actual limit of the variance in usage behaviour that could be explained by such models (Taylor and Todd, 1995b). Future investigations, however, should attempt to improve the explanatory power of the research model used in this study by including other potential determinants of EIS use such as "intrinsic motivation" (Venkatesh, 1999), "perceptions of system's compatibility" (Moore and Benbasat, 1996) and "perceptions of image enhancement" (Karahanna et al, 1999). Furthermore, the investigation of the linkage between use and the users' performance would add to the practical relevance of this line of research.

In this study perceived usefulness was treated as an independent variable that influences the behaviour of using EIS. Argument can also be made for the reverse of this hypothesis: that more EIS use leads to higher EIS perceived usefulness. In reality, the relationship between these two variables is probably complex and circular. While this study chooses to argue all hypotheses in the direction of usage because the current research examines the antecedents of executive information systems use. The investigation of the effect of the degree of EIS use on user perceptions of the system and the consequences of its use presents an area for extending the research model and for further publications from this work.

Most of the prior studies of EIS usage have ignored that executives can use their systems both directly and indirectly and that both modes of usage contribute to the individual and the organisational performance. One of the contributions of this study is including both direct and indirect use explicitly in the measure of EIS use. Thus in future publications the researcher intends to test the validity of the model in explaining direct vs. indirect use to determine the relative importance of the research variables in understanding the two types of use.

The finding that subjective norm is the most important determinant of EIS usage calls for future research to take a broader perspective of the EIS implementation process by considering the influence of other social factors such as the usage behaviour of significant others. Although the results showed that computer training has no impact on user perceptions, further investigation of this fully controllable variable is theoretically and practically important. Hence, future studies are encouraged to explore how different training policies can be used to influence user perception of EIS.

The relation of user perceptions to systems usage has received considerable support from this study as well as from prior research. This emphasises the need for more work to identify the key determinants that may influence such important beliefs. As suggested by Delone and Mclean (1989) the relevance of the variables to be included in a model depends on the objective of the study, the organisational context and the aspect of IS addressed by the study. Examples of potential external factors are: "computer self-efficacy" (Campeau and Higgens, 1995, Torkezadeh et al, 1999), information systems support (Igbaria et al, 1995; 1997). Also, vendor support (Yap et al, 1992), organisational characteristics (Bajwa, Rai, and Ramaprasad, 1998; Rai and

Bajwa, 1997), gender (Venkatesh and Morris, 2000), levels of environmental pressure/turbulence (Leidner, 1996).

Future research may closely examine the overall causal structure of the model using longitudinal studies. The research model presents a comprehensive, though simplified snapshot factor view of the EIS usage phenomenon, which is an inherently complex and interactive social process. Thus the body of knowledge concerning the important issues related to EIS usage can be further enhanced with qualitative studies that examine the interactions between the model constructs through case and action research. These efforts will provide valuable qualitative evidence, which the usage research to date seems to be lacking (Barki and Benbasat, 1996). Also future studies may adopt a wider approach to the study of EIS use in organisations by focusing on the social, political, and cultural dimension of such systems (Green and Murphy, 1996).

Basing the current investigation on one of the well-established theoretical foundations; TAM, makes it possible to extend and generalise the study findings into information systems other than EIS. However, it is possible that different factors will have different weightings in different environments and with different types of systems. Therefore, the replications of this study in different situations such as the World Wide Web usage would be useful in testing the external validity of the research model. Also testing the model in different cultures such as in developing countries would provide evidence concerning its international transferability.

Appendix 5-1: Cover Letter and Questionnaire

0171 351 4399 • Fax 0171 376 5127

COMSHARE

22 Chelsea Manor Street
London SW3 5RL

29 October 1998

Dear Customer,

At Comshare we try to help students researching into areas in which we work. This is the case with the questionnaire you will find attached with this letter.

Research of this kind is valuable to the industry and ultimately to yourselves through the development and distribution of software products that better meet your needs.

I would therefore ask that you take the small amount of time necessary to complete the questionnaire, or pass it to the relevant person within your organisation if not yourself.

I thank you in anticipation for your co-operation.

Yours sincerely

Nigel Youell

Nigel Youell
Marketing Director

Confidential Questionnaire
A Survey of Senior Managers' Use of Executive Information Systems

Manal El Kordy
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This survey is part of a doctoral research focusing on senior managers' utilisation of executive information systems (EIS). It aims to identify key strategies that could help improve the usefulness of such systems to managerial work.

The study defines Executive Information System as the computer based information system provided to you in your current position for the support of your information needs. If you don't have available such system please forward the whole package to a colleague who have one available.

Thank you very much for your assistance in this research

1- Is your EIS based on a specific software package?

Yes ☐ No ☐

2- If your answer to question one is yes, on what package / software is your EIS based?

Please specify _____

3- Please choose all the capabilities available in your EIS (tick as many as apply).

Read only standard reporting	☐	Exception reporting	☐
Ad-hoc/unscheduled query	☐	Drill down capability	☐
External databases	☐	What if analyses/modeling	☐
Simple analyses e.g. spreadsheets	☐	Soft data e.g. news, forecasts	☐

4- When using EIS, how often do you perform each of the following activities?

	never	less than once a month	monthly	weekly	daily
1. Read regular / standard EIS reports					
2. Request others to prepare customised reports					
3. Retrieve data on key performance indicators					
4. Detect trends in critical performance parameters					
5. Perform ad hoc querying of databases					
6. Access company news					
7. Monitor information about competitors					
8. Monitor national and/or international information					

5- On an average week, how much time do you usually spend using EIS?

_____ Hours / minutes

6- For how many years/months have you used EIS?

_____ Years / months

7- Approximately, what is the percentage of your information needs satisfied through the use of each the following information sources?

Information sources	% of information needs satisfied
1. Personal contacts/meetings	
2. Direct use of the EIS	
3. EIS output provided by others	
4. Paper- based sources	
Total	100%

8- For each of the following statements, please put a tick mark in the place that best describes your opinion.

	strongly disagree	Disagree	uncertain	agree	strongly agree
1. My use of EIS increases my productivity on the job					
2. My use of EIS makes it easier to do my job					
3. My use of EIS enhances my effectiveness on the job					
4. My use of EIS improves my job performance					

9- For each of the following statements, please put a tick mark in the place that best describes your opinion.

	strongly disagree	disagree	uncertain	Agree	strongly agree
1. I find EIS easy to interact with					
2. I find it easy to get EIS to do what I want it to do					
3. My use of EIS requires a lot of mental effort					
4. I find it is easy to become skilful at using EIS					

10- Please answer the following questions considering your overall responsibility for the development of EIS.

	yes	no
1. Were you the leader of the EIS project team?		
2. Did you have the responsibility for estimating development costs of EIS?		
3 Did you have the responsibility for requesting additional funds to cover unforeseen time / costs overruns?		
4. Did you have the responsibility for selecting the software and / or the hardware needed for EIS?		
5. Did you have the responsibility for the success of EIS?		
6. I had main responsibility for the development project during system definition		
7. I had main responsibility for the development project during physical design		
8. I had main responsibility for the development project during implementation		

11- On each of the following scales, choose the answer that best describes the importance and relevance of EIS to your work.

For me personally in my job I consider EIS to be:

Unimportant	1	2	3	4	5	6	7	Important
Essential	1	2	3	4	5	6	7	Nonessential
Trivial	1	2	3	4	5	6	7	Fundamental
Of no concern to me	1	2	3	4	5	6	7	Of concern to me
Irrelevant to me	1	2	3	4	5	6	7	Relevant to me
Matters to me	1	2	3	4	5	6	7	Doesn't matters to me

12- Please think about EIS as a whole and answer the following questions.

	hardly ever	25% of the time	50% of the time	75% of the time	always
1. Do you think the output is presented in a useful format?					
2. Is the information clear?					
3. Is the information accurate?					
4. Does EIS provide the critical information you need?					
5. Does EIS provide sufficient information?					
6. Does EIS provide up-to- date information?					
7. Do you get the information you need in time?					
8. Does EIS provide reports that are about exactly what you want?					
9. Does the system provides the precise information you need?					

13- To what extent are you expected by each of the following groups to use EIS?

	no extent	low extent	average extent	Great Extent	very great extent
1. Superiors					
2. Colleagues					
3. Subordinates					
4. Information systems staff					

14- Please think about the overall Information Systems (IS) environment in your organisation and answer the following questions.

	no extent	very low extent	low extent	average extent	great extent	very great extent
1. To what extent are IS staff informed about business plans and operations?						
2. To what extent is top management informed about information technology?						
3. To what extent does information technology impact the organisation's performance?						
4. To what extent does IS support many functions in the organisation?						
5. To what extent is information technology available throughout the organisation's premises?						
6. To what extent is IS performance evaluated in terms of contribution to the organisation's overall objectives rather than cost savings?						
7. To what extent is IS planning formalised?						
8. To what extent does IS planning take the business plans into consideration?						
9. To what extent is top management involved in IS planning?						

15- How long have you used computers in doing your work?

_____ Years / months

16- How would you rate your overall skills to use computers to do your job?

very low	low	average	high	very high

17- What is the extent of the computer-related training that you received from each of the following sources?

	non	little	average	high	extensive
1. Self training					
2. Company / in-house training					
3. Vendor training					
4. College training					

General information:

1- Job Title: _____

2- Main functional specialisation:

General ☐ Marketing, Sales, Advertising ☐

Production ☐ Finance, Accounting ☐

Other, please specify_____

3- Present organisational level:

Chief executive ☐

One level below the chief executive ☐

Two levels below the chief executive ☐

Other, please specify _____

4- Number of years in present position: _____

5- Number of years with managerial experience:_____

6- Gender: Male ☐ Female ☐

7- Age: _____

8- Number of years of completed education: _____

9- Principal activity of your organisation:

Finance / Banking / Insurance ☐ Local / central government ☐

Pharmaceuticals / Chemicals ☐ Public utilities ☐

Heath services ☐ Manufacturing / engineering ☐

Retail ☐ Other, please specify, _____

10- The approximate number of people your organisation employ: _____

11- The approximate annual turnover (budget if in public sector) of your organisation: _____

Thank you for completing the questionnaire, your help is very much appreciated

As a token of my appreciation for your time and effort in completing this survey, I would be glad to send you a complementary copy of the survey's "summary of results" report. If you would like to receive such copy, please attach one of your business cards.

Please return your completed questionnaire to me as soon as possible or by Friday 27 of November 1998 in the stamped self addressed envelope that has been provided for you.

Appendix 5-2: Factor Analysis of the Research Variables

Factor Analysis of the Research Variables

Communalities

	Initial	Extraction
BEHAV1	1.000	.542
INFOUSE	1.000	.605
USETIME2	1.000	.695
PRODUC	1.000	.788
JOBEASY	1.000	.749
EFFECT	1.000	.848
PERFORM	1.000	.805
EASYUSE	1.000	.736
GETODO	1.000	.711
EFFORT	1.000	.743
SKILLFUL	1.000	.757
SAT1	1.000	.674
SAT2	1.000	.634
SAT3	1.000	.598
SAT4	1.000	.736
SAT5	1.000	.659
SAT6	1.000	.671
SAT7	1.000	.691
SAT8	1.000	.750
SAT9	1.000	.783
INVOLV1	1.000	.762
INVOLV2	1.000	.776
INVOLV3	1.000	.798
INVOLV4	1.000	.831
INVOLV5	1.000	.852
INVOLV6	1.000	.846
SN1	1.000	.591
SN2	1.000	.751
SN3	1.000	.716
SN4	1.000	.595
SOFISTIC	1.000	.529
PART1	1.000	.723
PART2	1.000	.742
PART3	1.000	.713
PART4	1.000	.516
PART5	1.000	.677
PART6	1.000	.740
PART7	1.000	.798
PART8	1.000	.787
MAT1	1.000	.561
MAT2	1.000	.522
MAT3	1.000	.677
MAT4	1.000	.651
MAT5	1.000	.548
MAT6	1.000	.546
MAT7	1.000	.628
MAT8	1.000	.663
MAT9	1.000	.621
USESKILL	1.000	.672
EXPEIS	1.000	.652
TRAING1	1.000	.627
TRAING2	1.000	.601
TRAING3	1.000	.651
TRAING4	1.000	.626

Extraction Method: Principal Component Analysis.

Total Variance Explained

Component	Initial Eigenvalues		
	Total	% of Variance	Cumulative %
1	11.411	21.131	21.131
2	5.345	9.899	31.030
3	4.667	8.643	39.673
4	3.334	6.174	45.847
5	2.288	4.237	50.084
6	1.805	3.343	53.427
7	1.735	3.213	56.640
8	1.597	2.956	59.596
9	1.427	2.642	62.238
10	1.258	2.330	64.568
11	1.210	2.240	66.808
12	1.086	2.011	68.819
13	.980	1.816	70.634
14	.922	1.708	72.342
15	.883	1.635	73.977
16	.845	1.565	75.542
17	.800	1.481	77.023
18	.738	1.367	78.390
19	.709	1.313	79.704
20	.675	1.251	80.955
21	.627	1.161	82.115
22	.593	1.098	83.214
23	.577	1.068	84.282
24	.517	.958	85.240
25	.478	.885	86.126
26	.474	.877	87.003
27	.446	.826	87.828
28	.438	.812	88.640
29	.415	.768	89.408
30	.406	.752	90.160
31	.383	.710	90.870
32	.381	.705	91.575
33	.362	.670	92.245
34	.339	.627	92.873
35	.328	.608	93.481
36	.298	.552	94.032
37	.284	.526	94.558
38	.275	.509	95.067
39	.271	.502	95.569
40	.241	.446	96.016
41	.238	.441	96.457
42	.213	.394	96.851
43	.208	.385	97.236
44	.194	.359	97.594
45	.174	.322	97.916
46	.167	.310	98.226
47	.163	.301	98.527
48	.152	.282	98.809
49	.138	.255	99.064
50	.129	.239	99.303
51	.117	.217	99.520
52	9.705E-02	.180	99.699
53	9.179E-02	.170	99.869
54	7.055E-02	.131	100.000

Extraction Method: Principal Component Analysis.

Total Variance Explained

Component	Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %
1	11.411	21.131	21.131
2	5.345	9.899	31.030
3	4.667	8.643	39.673
4	3.334	6.174	45.847
5	2.288	4.237	50.084
6	1.805	3.343	53.427
7	1.735	3.213	56.640
8	1.597	2.956	59.596
9	1.427	2.642	62.238
10	1.258	2.330	64.568
11	1.210	2.240	66.808
12	1.086	2.011	68.819
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Extraction Method: Principal Component Analysis.

Component Matrix[a]

	Component					
	1	2	3	4	5	6
BEHAV1	.477	-7.286E-02	-.138	-.184	-4.429E-02	.106
INFOUSE	.586	-.173	6.435E-02	-9.185E-02	-3.515E-02	.223
USETIME2	.513	-.272	-1.067E-02	-.253	-.125	.194
PRODUC	.667	-.180	-.185	-.116	8.745E-02	.158
JOBEASY	.707	-.235	-.117	-7.064E-02	5.912E-02	.138
EFFECT	.743	-.164	-.165	-8.297E-02	2.847E-02	.198
PERFORM	.715	-.193	-.168	-2.542E-02	7.777E-02	.168
EASYUSE	.468	3.469E-02	.358	-.372	.380	.116
GETODO	.569	.108	.300	-.394	.229	.124
EFFORT	.407	2.888E-02	.337	-.364	.358	.156
SKILLFUL	.435	.119	.326	-.344	.343	.197
SAT1	.550	.201	.370	-.141	-.110	-.154
SAT2	.536	.125	.395	-.241	1.694E-02	-.104
SAT3	.478	-4.410E-02	.283	-8.249E-02	-1.126E-03	-.451
SAT4	.668	-1.460E-02	.259	-7.438E-02	-.375	-.240
SAT5	.656	-2.239E-02	.234	-.157	-.276	-.203
SAT6	.609	-9.911E-02	.227	-4.778E-02	-7.524E-02	-.335
SAT7	.612	1.386E-02	.342	-1.813E-02	-.138	-.336
SAT8	.687	.156	.259	-7.249E-02	-.301	-.170
SAT9	.665	6.420E-02	.317	-6.877E-02	-.354	-.221
INVOLV1	.666	-.156	-.438	.190	7.545E-02	-.120
INVOLV2	.625	-.214	-.428	.268	.110	-.169
INVOLV3	.604	-.223	-.450	.313	.165	-9.356E-02
INVOLV4	.595	-.168	-.461	.357	.183	-.121
INVOLV5	.591	-.187	-.488	.320	.180	-.131
INVOLV6	.624	-.165	-.453	.350	.173	-.139
SN1	.498	-.233	-.100	-5.664E-02	-.112	.158
SN2	.640	-.202	-.134	2.763E-02	-.107	.250
SN3	.491	-.125	-.178	2.971E-02	-.212	.307
SN4	.387	-.123	-.115	8.452E-02	-.251	.286
SOFISTIC	.436	.152	-1.527E-02	-.144	6.921E-02	7.887E-02
PART1	.230	.727	-.303	-9.896E-02	-.112	6.597E-02
PART2	.157	.756	-.263	8.285E-02	-.138	-1.042E-02
PART3	.157	.705	-.258	.101	-.105	1.151E-02
PART4	.236	.591	-.179	1.670E-02	4.781E-02	3.282E-02
PART5	.317	.698	-.212	-1.202E-02	8.086E-02	1.961E-02
PART6	.183	.760	-.247	-.124	-6.742E-02	-2.214E-02
PART7	.208	.780	-.254	-4.614E-02	-4.390E-02	5.291E-02
PART8	.259	.786	-.253	-3.100E-02	3.877E-02	8.231E-02
MAT1	.195	4.357E-02	.425	.426	-.165	.257
MAT2	.116	.142	.390	.401	-.188	.243
MAT3	.275	3.296E-02	.182	.424	.311	-.166
MAT4	.133	.148	.260	.456	.406	-.143
MAT5	.161	.123	.431	.307	.254	-9.691E-02
MAT6	.277	2.729E-02	.435	.318	-.108	.160
MAT7	8.454E-02	7.252E-02	.451	.524	3.548E-02	.271
MAT8	.176	.195	.422	.586	-3.021E-02	.158
MAT9	.236	.142	.345	.469	-8.149E-02	.315
USESKILL	6.082E-02	.311	.225	-.113	.583	5.593E-03
EXPEIS	.158	-5.967E-02	-3.503E-03	-8.707E-02	4.254E-02	7.380E-02
TRAING1	.122	-2.157E-02	.168	-8.888E-02	.466	-7.578E-04
TRAING2	-1.550E-02	.132	.263	.292	-4.083E-02	-.195
TRAING3	1.998E-02	.297	.111	4.062E-02	9.551E-02	-2.201E-02
TRAING4	-1.756E-02	.187	5.270E-02	.121	.149	-.160

Extraction Method: Principal Component Analysis.

Component Matrix[a]

	Component					
	7	8	9	10	11	12
BEHAV1	.239	.148	-.248	-.100	.263	-.153
INFOUSE	.230	1.616E-02	-3.777E-02	-.105	.271	.170
USETIME2	.169	.125	6.392E-02	-8.888E-02	.278	.328
PRODUC	.257	2.557E-02	-.248	.120	-.272	-.119
JOBEASY	.111	-3.094E-02	-.287	.106	-.213	-1.738E-02
EFFECT	.170	-7.342E-02	-.271	4.387E-02	-.281	-7.330E-02
PERFORM	.162	-3.390E-02	-.310	6.774E-02	-.236	-.102
EASYUSE	-.242	.123	-2.223E-02	6.906E-02	-7.394E-02	8.424E-02
GETODO	-.178	.106	-7.510E-02	-.104	7.701E-03	5.842E-02
EFFORT	-.371	.140	.117	1.444E-02	-8.398E-02	-1.724E-04
SKILLFUL	-.346	.192	8.064E-02	5.258E-02	7.416E-02	-3.710E-02
SAT1	3.093E-02	-4.960E-02	.241	3.252E-02	-.274	-3.005E-02
SAT2	-9.910E-02	-6.046E-02	.211	4.991E-02	-.169	-.131
SAT3	-3.272E-02	-.163	-7.208E-02	.142	-9.118E-02	.126
SAT4	9.128E-02	-4.142E-02	-7.502E-02	-5.149E-02	-2.803E-02	-4.913E-03
SAT5	4.711E-02	-2.292E-02	-4.864E-02	1.988E-02	9.939E-02	.127
SAT6	-4.575E-02	-5.264E-03	-.166	.135	.222	-.146
SAT7	-8.237E-02	3.567E-02	-.118	.141	.114	-.112
SAT8	-4.690E-02	1.656E-02	.154	-.175	-1.713E-03	-7.046E-02
SAT9	-5.673E-02	-3.548E-02	9.323E-02	- 206	3.734E-02	-5.931E-03
INVOLV1	-.138	7.816E-02	7.270E-04	-5.588E-02	-3.773E-02	.124
INVOLV2	-.101	.112	4.037E-02	-6.653E-02	6.274E-02	.105
INVOLV3	-.145	.110	-9.797E-03	-5.654E-02	8.318E-02	5.884E-02
INVOLV4	-.144	.135	.135	-4.469E-02	6.388E-04	-4.766E-02
INVOLV5	-.177	.151	.136	-3.233E-02	-2.318E-02	-6.165E-02
INVOLV6	-.176	.107	8.081E-02	-5.697E-02	1.454E-03	3.447E-02
SN1	.147	-.160	.389	-.173	9.383E-02	-2.252E-02
SN2	.133	-.233	.346	7.343E-02	-9.757E-02	3.144E-02
SN3	-6.298E-02	-.256	.382	.260	1.990E-02	6.308E-02
SN4	.125	-.146	.249	.382	1.073E-02	-.143
SOFISTIC	.385	.166	-6.391E-02	-.183	.264	3.472E-02
PART1	-1.041E-02	6.953E-03	-4.601E-02	-2.712E-02	-4.492E-02	.136
PART2	-2.564E-02	3.392E-02	-4.035E-02	9.489E-02	.113	-.158
PART3	9.897E-02	-1.342E-02	6.651E-03	2.766E-02	7.134E-02	-.296
PART4	-6.315E-02	-5.710E-02	9.199E-02	-3.934E-03	.119	-.210
PART5	-8.307E-02	-9.379E-02	-4.709E-03	-.129	-1.096E-02	-7.004E-02
PART6	-6.323E-02	-2.975E-02	-.113	4.400E-02	-6.092E-02	.158
PART7	-6.018E-02	-6.217E-02	-5.649E-02	5.170E-02	-6.849E-02	.240
PART8	2.242E-02	-.124	-1.280E-02	-5.292E-03	5.857E-03	.115
MAT1	-.116	8.483E-02	5.481E-02	1.120E-02	.204	1 609E-02
MAT2	-.162	2.277E-02	-.120	-7.853E-03	6.785E-02	.189
MAT3	.200	-.414	-.154	-3.006E-02	.119	.113
MAT4	4.514E-02	-.300	-1.994E-02	.131	.112	.170
MAT5	.114	-.274	3.336E-02	.213	1.670E-03	.133
MAT6	2.793E-02	.170	-7.536E-02	-.312	-2.840E-03	-9.221E-02
MAT7	-.106	.148	1.046E-02	.158	-6.434E-02	-5.903E-03
MAT8	-7.226E-03	2.509E-02	-.107	-6.315E-02	-5.341E-02	-.164
MAT9	-.110	4.281E-02	-.148	-.221	-.110	-5.965E-02
USESKILL	.332	-2.754E-03	.190	-6.864E-02	.127	-3.509E-02
EXPEIS	-8.501E-02	9.679E-02	-.190	.585	.443	-.136
TRAING1	.263	-.371	.105	-.255	5.473E-02	-.270
TRAING2	.368	.390	.102	.147	-.259	4.014E-02
TRAING3	.417	.393	.130	.146	-.112	.399
TRAING4	.305	.518	.285	.128	1.279E-02	-.258

Extraction Method: Principal Component Analysis.

a. 12 components extracted.

Key of the Research Vaiables:
EIS use items: BEHAV1, INFOUSE, USETIME2.
Perceived Usefulness items:PRODUC, JOBEASY, EFFECT, PERFORM.
Perceived ease of use items: EASYUSE, GETODO, EFFORT, SKILLFUL.
Perceived information quality items: SAT1, SAT2, SAT3, SAT4, SAT5, SAT6, SAT7, SAT8, SAT9.
User involvement items:INVOLV1, INVOLV2, INVOLV3, INVOLV4, INVOLV5, INVOL
Subjective norm items: SN1, SN2, SN3, SN4.
Facilitating conditions: SOFISTIC.
User participatio items: PART1, PART2, PART3, PART4, PART5, PART6,PART7, PART8.
IS matriry items: MAT1, MAT2, MAT3, MAT4, MAT5, MAT6, MAT7, MAT8, MAT9.
User experience items: USESKILL, EXPEIS.
Computer training items: TRAING1, TRAING2, TRAING3, TRAING4.

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